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WABASH RIVER BASIN COMPREHENSIVE STUDY. VOLUME I. MAIN REPORT.(U)

JUN 71

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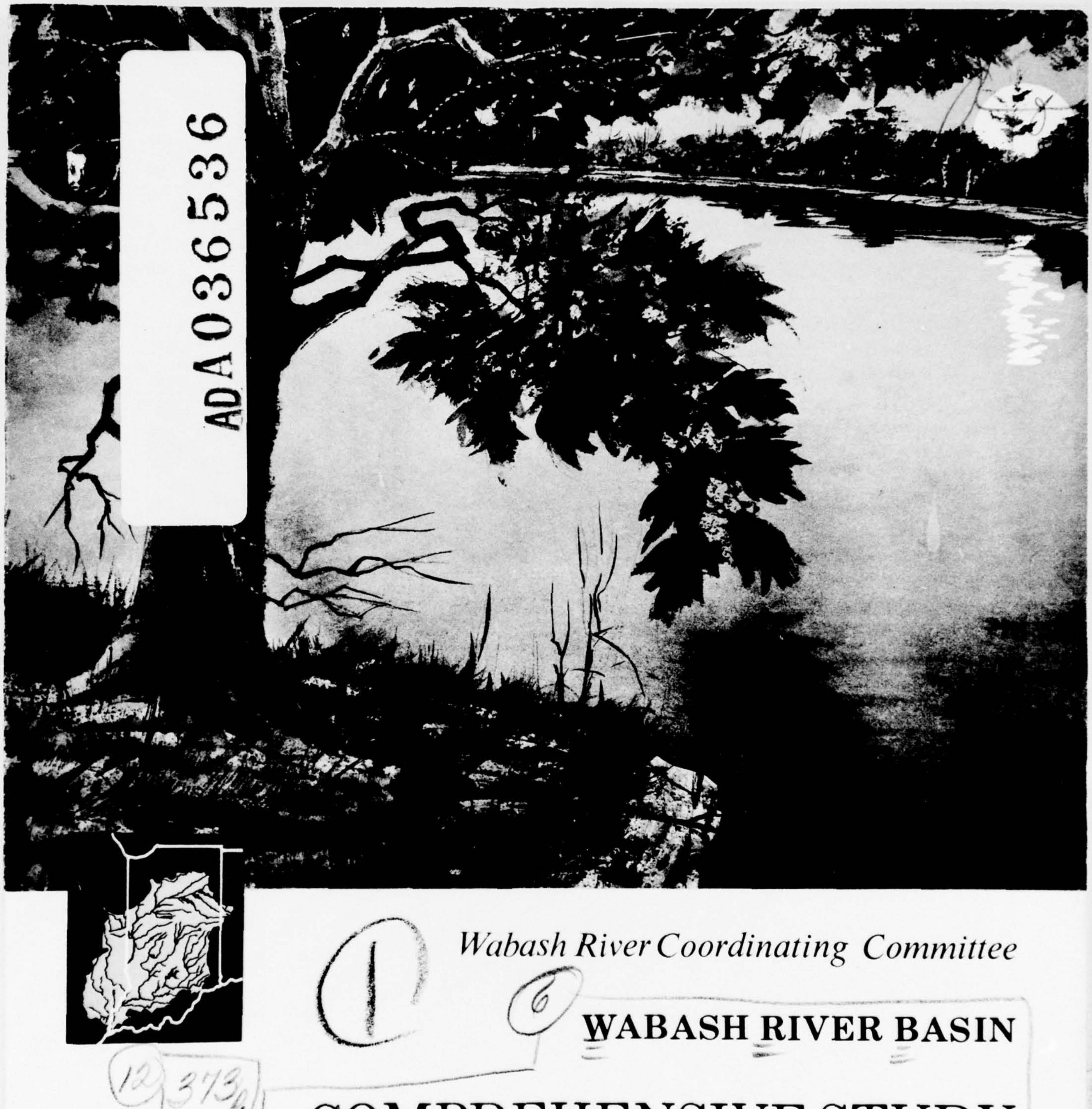

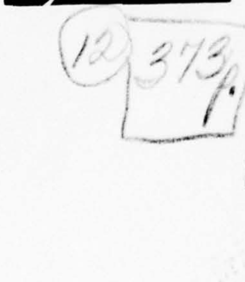

Wabash River Coordinating Committee

WABASH RIVER BASIN

COMPREHENSIVE STUDY,

VOLUME I.

Main Report

JUNE 1971

348

WABASH RIVER BASIN

COMPREHENSIVE SURVEY

VOLUME INDEX

MAIN REPORT

WABASH RIVER BASIN COMPREHENSIVE STUDY

WABASH RIVER COORDINATING COMMITTEE

Prepared by the U. S. Army Corps of Engineers

Louisville District

in cooperation with

Member Agencies

of the

Wabash River Coordinating Committee

COMPREHENSIVE BASIN STUDY
WABASH RIVER BASIN
ILLINOIS, INDIANA AND OHIO
JUNE 1971

This study has been reviewed and accepted by the Wabash River Coordinating Committee composed of representatives of the Departments of Agriculture; Army; Commerce; Health, Education and Welfare; Interior; and Transportation; the Environmental Protection Agency; the Federal Power Commission; the Wabash Valley Interstate Commission; and the States of Illinois, Indiana, and Ohio. The Corps of Engineers, Louisville District, acted as the chairing agency. Individual agency comments are presented in Attachment B of this volume.

The Wabash River Coordinating Committee report was prepared at field level and presents a proposed plan for the development and management of the water and related land resources of the Wabash River basin. The report is subject to review by the interested Federal agencies at departmental level, by the Governors of the affected States, by the Ohio River Basin Commission, and by the Water Resources Council prior to its transmittal to the President of the United States for his review and ultimate transmittal to the Congress for its consideration and authorizing Federal participation in implementing the plan.

Thomas B. Evans Thomas B. Evans U. S. Department of Agriculture	Lenard B. Young Lenard B. Young Federal Power Commission
* Represented by Federal Highway Administration formerly Bureau of Public Roads U. S. Department of Commerce	George D. Gettinger George D. Gettinger Wabash Valley Interstate Commission
Donald W. Marshall Donald W. Marshall U. S. Department of Health, Education and Welfare	Ray C. Dickerson Ray C. Dickerson State of Illinois
Burton H. Atwood Burton H. Atwood U. S. Department of the Interior	John R. Lloyd John R. Lloyd State of Indiana
William D. Richardson William D. Richardson *U. S. Department of Transportation	S. L. Frost S. L. Frost State of Ohio
Francis T. Mayo Francis T. Mayo Environmental Protection Agency	John T. Rhett Colonel John T. Rhett Chairman U. S. Department of the Army

FIGURE A

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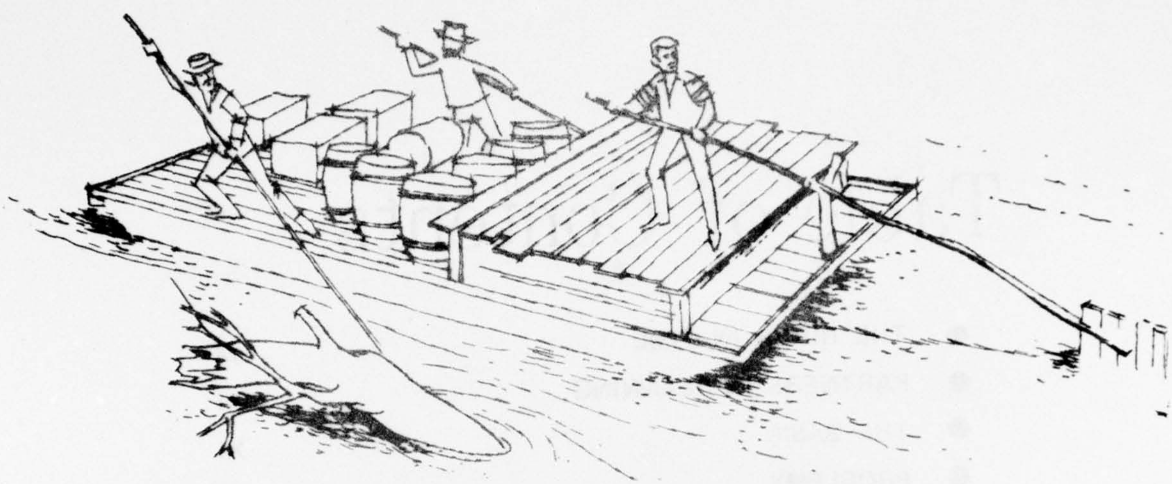
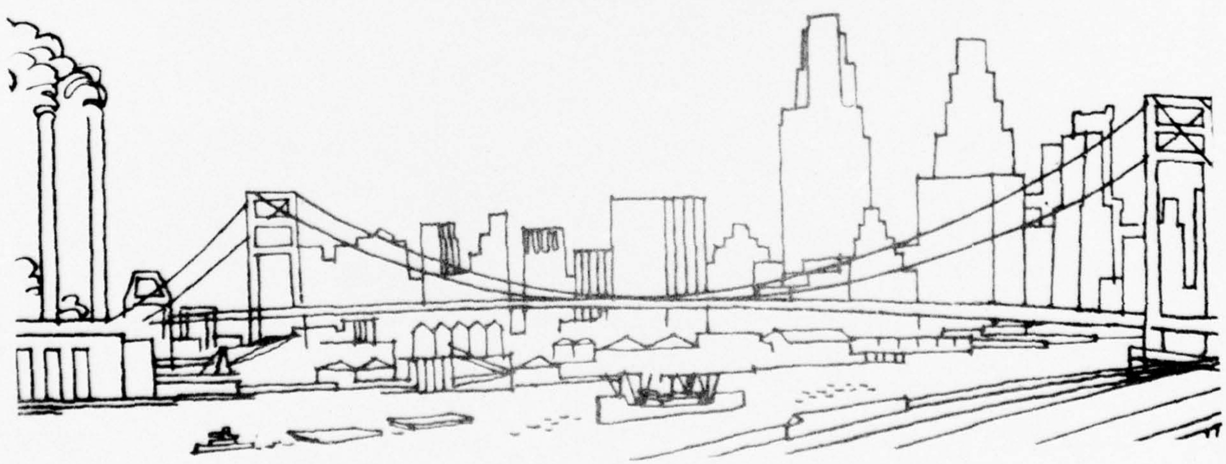


From Frontier....



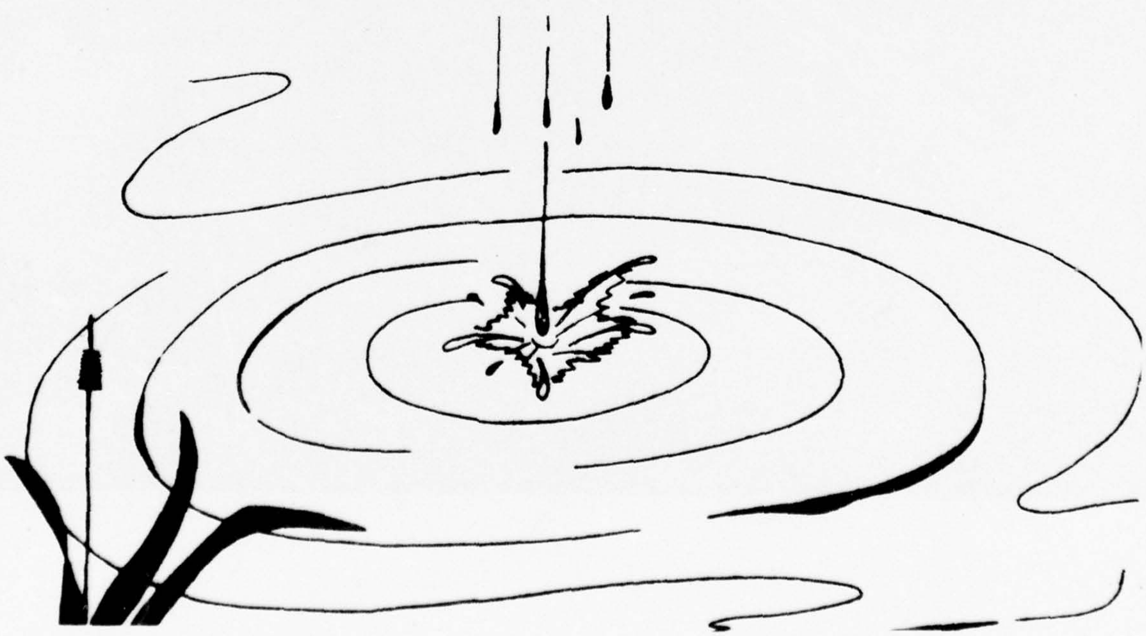
....To Inland Empire

FIGURE B

WABASH RIVER BASIN COMPREHENSIVE STUDY

Summary

This section presents for the consideration of local interests a summary of information and data pertinent to the studies for defining a comprehensive water resources plan for the Wabash River basin and its tributaries. The study was directed by the Wabash River Coordinating Committee composed of participating Federal and State agencies under the permanent Chairmanship of the District Engineer, Louisville District, Corps of Engineers. The study report consists of a main report and 13 supporting appendices which contain the study details and programs of the preparing agencies.



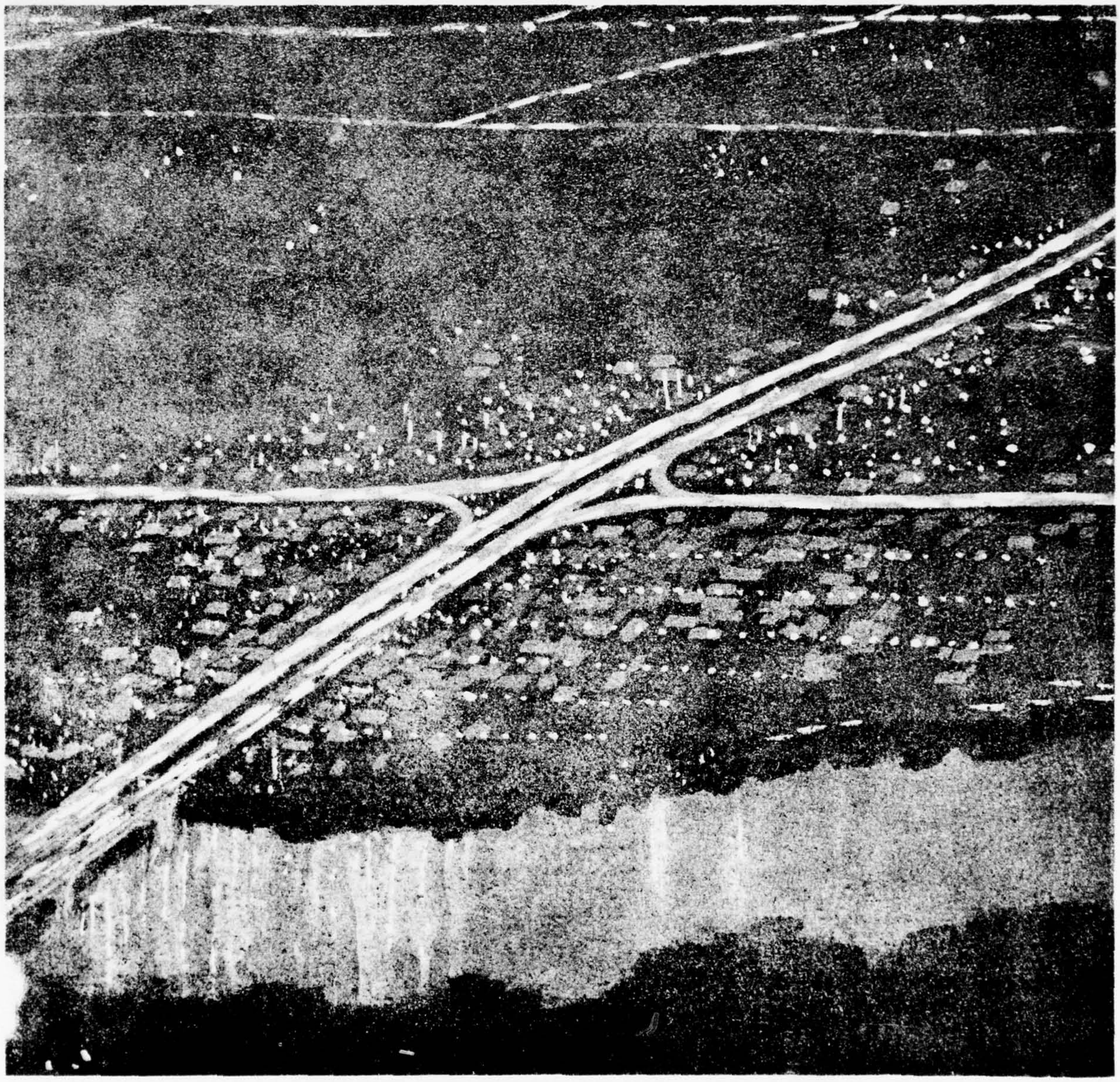


FIGURE C

The River in Time

Explorers, missionaries, fur traders, settlers. Indian intrigue, military campaigns, the drama of the American Frontier was here on the banks of the Wabash River. It has been said to know America, one must take a long look at this river, because it was here that the very shape of this great nation was determined during the Revolutionary War, setting the southern boundary of Canada at the Great Lakes and opening the western frontier country. The French explorers called the river "Ouabache", their spelling of the Indian word which meant white. Since the days of the explorers, the river has carried the people's commerce; its banks have furnished them food; its depths have furnished them drink.

As time has progressed, so have the people along the river and their numbers. With their progress and increasing numbers, pollution sediment and some of man's alterations have changed the river from the glistening silver-white waters of bygone days to a stream that no longer meets all the burdens and demands placed upon it. The time for appraisal of these demands is now at hand. Recognizing this, the Congress has directed that a study of the Wabash River be made in order to develop a proper use of the river's resources.


UNITED STATES DEPARTMENT OF AGRICULTURE
DEPARTMENT OF COMMERCE
UNITED STATES OF AMERICA
DEPARTMENT OF HEALTH EDUCATION AND WELFARE
U.S.A.
U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849
WABASH VALLEY INTERSTATE COMMISSION
THE GREAT SEAL OF THE STATE OF OHIO
SEAL OF THE STATE OF INDIANA
1816
DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION
DEPARTMENT OF DEFENSE

FIGURE D

Partners in Planning

The Wabash River Basin Comprehensive Study is part of the national comprehensive river basin planning program that has developed from recommendations in a 1961 report of the Senate Select Committee on National Water Resources. It is the basic objective of this program to encourage the conservation, development, and utilization of water and related land resources of the United States on a coordinating basis by the Federal Government, States, localities, business enterprises and individuals.

To carry out these objectives for this study, the capabilities of Federal and State agencies with expertise in many fields were utilized. Major contributions were as follows:

THE CORPS OF ENGINEERS has had the responsibility of coordinating the study, consolidating information from studies of other agencies and processing the Committee report. Studies included the identification of development and conservation needs; identification and evaluation of reservoir sites, local protection projects, and other structural features; and the holding of public hearings and meetings pursuant to the comprehensive basin plan.

THE DEPARTMENT OF AGRICULTURE, through the Economic Research Service, Forest Service and Soil Conservation Service furnished special studies covering the agricultural and forest economy of the basin, land use, cover, irrigation, rural water supply, sedimentation and upstream watershed control, including land treatment measures and multipurpose structures.

THE DEPARTMENT OF COMMERCE has participated through four agencies including the Office of Business Economics, Census Bureau, Coast and Geodetic Survey, and *Environmental Science Service Administration.* All were called on to furnish information, which in itself represents decades of invaluable study and service through many continuing programs.

THE DEPARTMENT OF HEALTH, EDUCATION AND WELFARE through the Public Health Service, conducted a study on the public health aspects of water and related land resource development. The principal health evaluation aspects covered water supply and recreation.

THE DEPARTMENT OF THE INTERIOR. The Department of the Interior had six agencies involved in the study, each with its unique responsibility. They include:

The Bureau of Mines supplied an inventory of the type and extent of the mineral industry, both current and projected. Major reservoir project sites were reviewed for existing and potential mineral resources.

The Bureau of Outdoor Recreation made studies of the supply and demand aspects of recreation within a distinct area of influence. From this, needs were evaluated and a recreation plan of improvement developed.

The Bureau of Sport Fisheries and Wildlife provided an inventory of the fish and wildlife needs, studied the effects of water resource development and recommended measures to secure the maximum fish and wildlife benefits.

The Federal Water Quality Administration determined present minimum stream flows, present and future municipal and industrial water supply needs and aided in the development of withdrawal schedules, and the volume determinations for water quality and water supply storages in reservoir project plans under consideration. They also evaluated water quality problems in the basin and the need for remedial measures necessary to meet established water quality standards.1/

1/ Work completed by Environmental Protection Agency.

The U. S. Geological Survey prepared a report on ground water with a treatise on the geology affecting it, location, extent, hydrologic characteristics and sources.

The National Park Service inventoried the historical, archeological, and natural science aspects of the Basin.

THE DEPARTMENT OF TRANSPORTATION through the Federal Highway Administration, reviewed proposals for highway relocations and provided needed coordination with existing highway programs.

THE FEDERAL POWER COMMISSION analyzed present and future power requirements of the Wabash River Basin; estimated the types of generating capacity required to serve the load, including identification of potential hydroelectric power plants, and estimated the water requirements for steam electric cooling purposes.

THE WABASH VALLEY INTERSTATE COMMISSION participated on a broader front informing the public, encouraging coordination and making special studies.

THE STATES OF ILLINOIS, INDIANA AND OHIO furnished valuable information, technical review and staff for work-group activities throughout the investigation of the report.

A Coordinating Committee for the Wabash River Basin was organized at the outset to comment on and coordinate study matters. It consisted of official representatives from each of the following jurisdictions and agencies:

Corps of Engineers	Federal Power Commission
Department of Agriculture	Wabash Valley Interstate Commission
Department of Commerce	State of Illinois
Department of Health, Education and Welfare	State of Indiana
Department of Interior	State of Ohio
Department of Transportation	

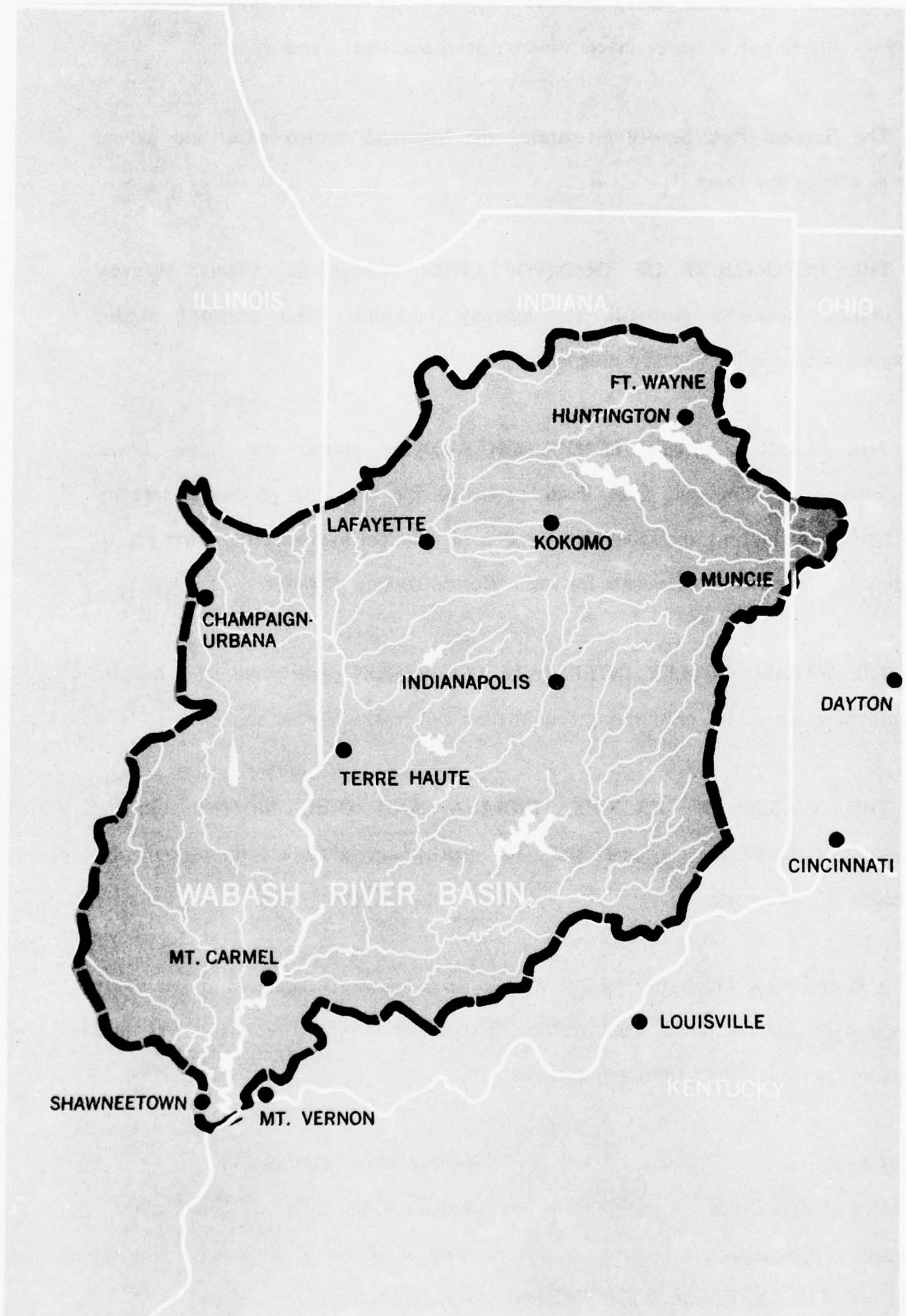

ILLINOIS
INDIANA
OHIO
FT. WAYNE
HUNTINGTON
LAFAYETTE
KOKOMO
MUNCIE
CHAMPAIGN-URBANA
INDIANAPOLIS
DAYTON
TERRE HAUTE
CINCINNATI
WABASH RIVER BASIN
MT. CARMEL
LOUISVILLE
KENTUCKY
SHAWNEETOWN
MT. VERNON

FIGURE E

The Basin

The Wabash River, the second largest tributary of the Ohio River, originates in Mercer County, Ohio, about 15 miles east of the Indiana–Ohio state line. It flows in a northwesterly direction to the vicinity of Huntington, Indiana, and thence westerly and then southerly, forming the lower boundary between Indiana and Illinois until it joins the Ohio River about halfway between Mt. Vernon, Indiana and Shawneetown, Illinois. The principal tributaries entering the Wabash along its 475 miles of length are the Salamonie, Mississinewa, Eel, Tippecanoe, Vermilion, Embarras, White, Patoka and Little Wabash Rivers. Together, the Wabash River and all of its tributaries drain an area of 33,100 square miles which encompass about two-thirds of Indiana, one-sixth of Illinois and 319 square miles of Ohio.

The terrain in the Wabash River drainage basin varies considerably from one area to another. In the north the land has a flat to a general rolling character, while in the south it tends to be hilly. However portions of the Wabash and many of its tributaries flow through flat country with poor natural drainage. Throughout the basin, streambeds have relatively little slope and shallow banks.

Like the terrain, the economic characteristics vary considerably from one area to the other. Traditionally, most of the basin has been devoted to agriculture but significant industrialization has taken place in numerous locations. Principal among these locations are Indianapolis, Anderson, Marion, Kokomo, Muncie, and Terre Haute, Indiana and Danville and Champaign, Illinois. In 1960, the population of the Wabash Basin was about 3,100,000. Of this number, approximately half were living in rural areas and half in urban developments. Looking forward to the year 2020, population projections indicate that the total population will increase to about 6,380,000 of which some 38 percent will be in rural areas, while 62 percent will be located in cities and towns.

FIGURE F

TABLE A

FLOOD DAMAGES[1/]

Subbasin	Average Annual Flood Damages ($1,000)
Upper Wabash River	2,781
Middle Wabash River	4,406
Embarras River	2,782
East Fork White River	7,742
West Fork White River	11,817
Patoka River	2,103
Little Wabash River	3,904
Lower Wabash River	2,645
Wabash River Basin Total	38,180

1/ Flood damages are mainstem and upstream as of 31 December 1968.

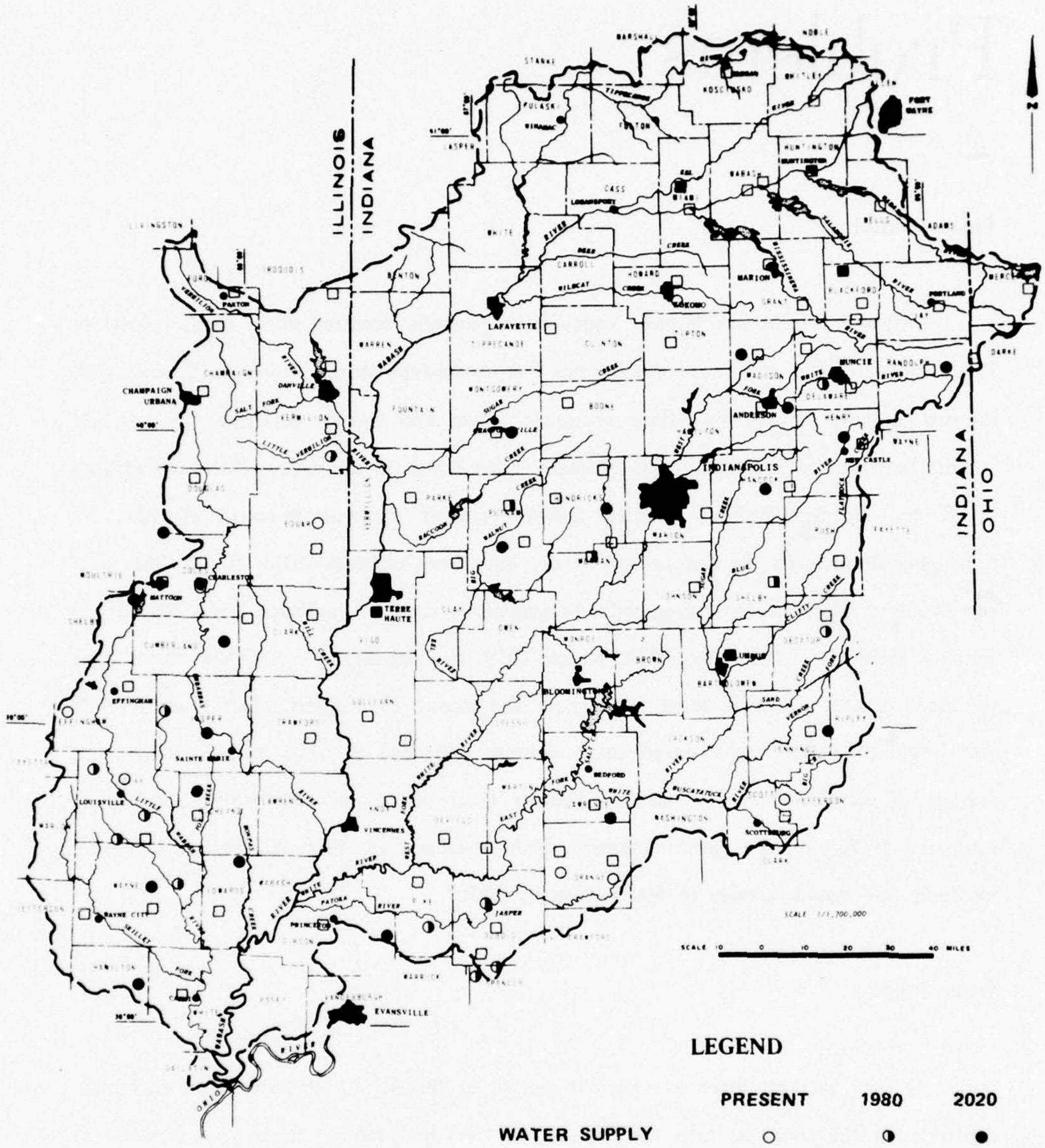
Problems

Flood Control

Major floods in the Wabash Valley have generally occurred either in the winter or in the spring of the year, when heavy rains from wave-type storms follow each other with unusual rapidity cause devastating economic losses and human suffering. The earliest settlers have set down recollections of many great floods in the valley. Historical writings about the frontier Wabash country indicate several explorations were curtailed by rampaging floodwaters. In this century, there have been eighteen major floods. The most significant of these, in descending order or magnitude occurred in March 1913, May 1943, January–February 1950, May 1933, March 1939, and January 1930. Other storms have produced greater floods in some tributaries. The record 1913 flood under today's prices and levels of development would cause damage estimated at $127 million dollars. An average of all flood damages in the Wabash River basin, under present conditions, is estimated at $39 million dollars annually. Without benefit of additional damage reduction measures this would increase to $90 million by 2020.

Water Supply

On the average, there is sufficient rainfall in the Wabash Basin to meet all human demands on the river far into the future. But "average" rainfall doesn't go very far to insure the proper development and protection of safe, adequate water supplies. These are required for the balanced socio-economic growth of the basin. With the increasing number of persons expected to reside within the Wabash service area, the growing economic activity, the rising standard of living and many new and improved water-using household devices, water requirements are increasing. Currently, most municipal and industrial water

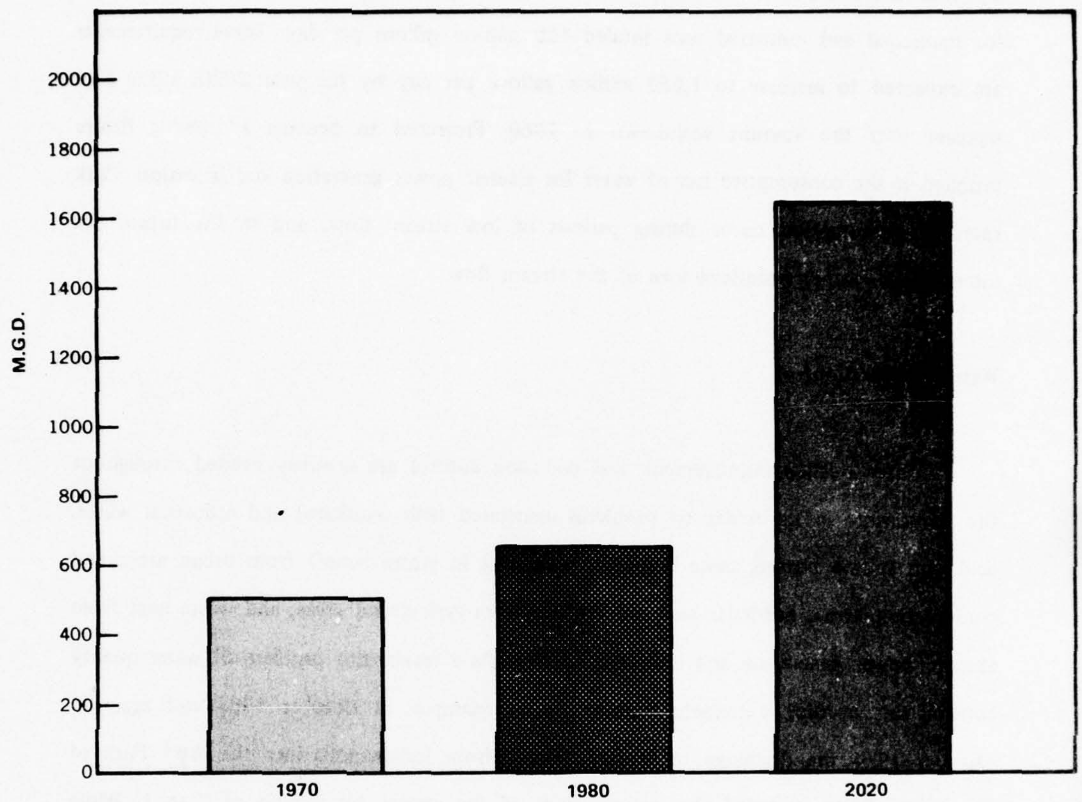


LEGEND

	PRESENT	1980	2020
WATER SUPPLY	○	◑	●
WATER QUALITY	□	◧	■

WATER SUPPLY & WATER QUALITY POINTS OF NEED

FIGURE G



TOTAL BASIN WATER SUPPLY REQUIREMENTS

FIGURE H

TABLE B

WATER SUPPLY PROJECTIONS
FOR FIVE LARGE CITIES[1/]
(AVERAGE DAILY IN MGD)

City	1970	1980	2020
Champaign	12.8	16.0	32.5
Danville	12.7	16.4	43.8
Indianapolis	149.0	174.0	360.0
Kokomo	25.6	33.1	84.8
Terre Haute	32.5	43.0	126.5

1/ Dates from Appendix F, Wabash Comprehensive

is obtained from wells, streams and reservoirs. The 1960 fresh water supply requirements for municipal and industrial uses totaled 460 million gallons per day. These requirements are expected to increase to 1,650 million gallons per day by the year 2020, a 3.6 fold increase over the amount withdrawn in 1960. Projected to become a growing future problem is the consumptive use of water for electric power generation and irrigation. Peak rates of consumption occur during periods of low stream flow, and in the future can interfere with other beneficial uses of the stream flow.

Water Quality Control

Water quality improvement and pollution control are urgently needed throughout the basin, due in particular to problems associated with municipal and industrial waste, acid and sulfate bearing mine drainage, pollutants in storm runoff from urban areas and construction areas, nutrients and soil erosion from agricultural areas, and waste heat from electric power generation and industrial cooling. As a result, this problem of water quality control can become extremely serious. As an example, in October 1963 and again in October 1964 the discharge of treated sewage from Indianapolis into the West Fork of the White River exceeded the natural flow of the stream by a ratio of 2 to 1. While there are several badly degraded areas in the Wabash River basin, the worst and largest is that reach of West Fork White River through and downstream from Indianapolis at least to Martinsville.

Recreation

The Wabash Basin, like many other areas of the United States, is confronted with an increasing population, increasing urban concentration, increasing per capita real income, increasing leisure time, increasing personal mobility, increasing knowledge of recreation opportunities and changing attitudes towards recreation.

Studies indi[illegible]te that if the above trend continues, by the year 2020, demands for outdoor r[illegible] resources and facilities by the people of the Wabash River service area

will be about four times the present level. Currently over 17 million visitor days are estimated for the utilization of the Basin's recreation facilities.

To give the proper perspective to the immensity of future recreation needs, one might examine the projection of future recreation demand in figure J.

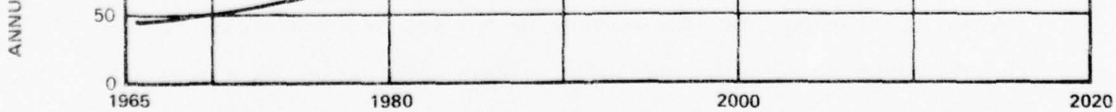
Other Needs

The human environment is made up of all the earth, the planets and man's modifications to them. Since water resource development, hand in hand with conservation measures, can contribute significantly to our quality of life, the yet unquantified problems of our environment require consideration along with the more obvious which have been described in the foregoing paragraphs.

Opportunities for generation of hydroelectric power are limited because of the nature of the terrain in the Wabash area. However, in considering any program of water resource development needs, the needs of electric power and the merits of its generation from hydro-power deserve careful examination. Water requirements for steam electric cooling must also be taken into consideration.

The use of water for irrigation purposes is a possibility which has received only limited attention in the past. There are indications that economic benefits might be achieved if additional supply can be made available economically. Consequently, the needs of water for this purpose have merited serious study. It is projected that the irrigated acreage will increase three times the current 13,800 acres by 2020. Finally, there is navigation. Anyone that has stood on the banks of the lower Ohio River near the mouth of the Wabash, has witnessed the modern towboat, making its way slowly through the water, pushing 1000 feet or more of barges in front of it. Perhaps we may ponder the economic effects of this great Ohio waterway, the fact that the Indians and early settlers used the Wabash for navigation, and thinking of these things together, we may question the possibilities of a modern Wabash waterway. This very question of the need for navigation, has deserved a review, and is currently being given consideration in a separate study.

FIGURE I



OUTDOOR RECREATION DEMAND

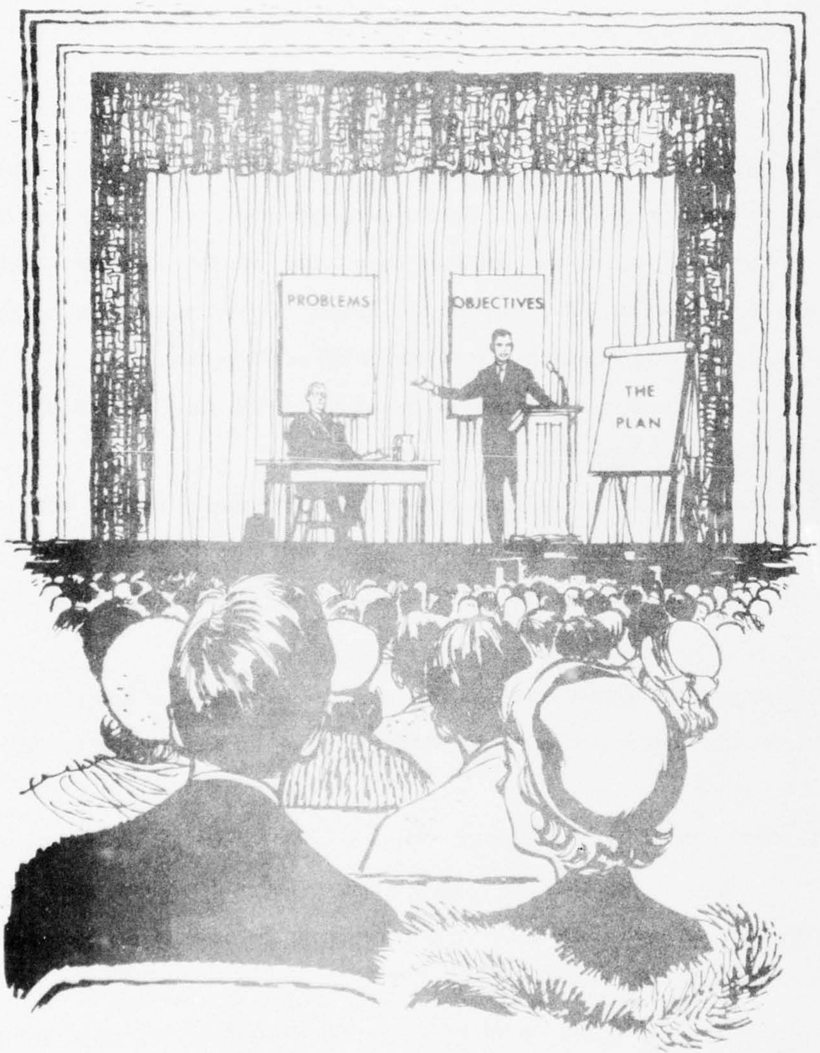
FIGURE J

Planning Objectives

The objective of the Wabash Comprehensive Study has been to identify, evaluate and propose a water and land resource plan for meeting problems and needs as they arise. Such a plan would assure the optimum contribution to the economic, regional, environmental and social well being of the people. To accomplish the optimum contribution the foregoing elements have been weighed in a matrix of many factors:

- The economic element is measured by the amount which the beneficial effect exceeds the cost in dollar terms.
- The regional element is highly oriented towards the economics of national income efficiency, but specifically addresses itself toward increasing the region's income, employment, and enhancing the regional environment, economic base, and social well-being.
- The environmental element considers that resources are exhaustible and planning must include conservation concepts which will tend to preserve the essential qualities of life.
- The social element is a recognition that a perfect balance of the foregoing elements is not possible. The non-economic values of society must be incorporated; an even distribution to each person in the basin of the economic and intangible benefits must be attempted.

The Comprehensive Plan guided by each of the four basic planning elements or objectives was ultimately determined by modifying a national income efficiency plan in various ways to accommodate the best possible balance of interests in a solution to the water problems and needs of the people of the Wabash River Basin.


PROBLEMS
OBJECTIVES
THE
PLAN

The Recommended Plan

Features of the recommended comprehensive plan for the Wabash in addition to those projects currently included in agency programs are as follows:

Thirteen major multiple purpose reservoirs; 6 for Early Action, 7 in the Long Range Plan.

A total of 147 small watershed projects for flood control, water supply, water quality control and recreation – 85 watersheds for Early Action, 62 in the Long Range Plan.

The Comprehensive Plan is limited to recommendations for advanced waste treatment sewage service areas; 112 areas for Early Action, 64 in the Long Range.

Two coal mine drainage pollution abatement projects for Early Action located in the Patoka and Middle Wabash Subbasins.

For municipal and industrial water supply, a number of communities are projected to need additional supplies; 69 areas for Early Action, 190 in the Long Range Plan.

Sixteen local flood protection projects for flood control, agricultural water management and regional development; 13 for Early Action, 2 in the Long Range Plan.

Regional Element - Three regional centers1/; three power development areas1/; a 212 mile scenic parkway from Old Shawneetown, Illinois to Lafayette, Indiana with a trail system; and four local protection projects which are included in the above item.

Preservation of stream fishery and fishing access to maintain and provide for a future fishery habitat.

Preservation of 3,259 miles of stream fishery corridor to maintain and provide for a future fishery habitat.

Land treatment and conservation measures to reduce erosion and local rainfall runoff on 13.5 million acres; 8.4 million for early action, 5.1 million for long range.

Studies – Reservoir regulation study to determine optimum regulation patterns for basic reservoirs with special consideration to the aquatic environment; land use study for establishing existing land use patterns, for designing future land use patterns and for giving detailed project study to the environmental corridor and stream fishery corridor systems. study for reconstitution of Grand Lake, Ohio.

The comprehensive plan for water and related land resources includes existing projects and programs, and those under way; projects authorized for construction by the Congress; and the additional projects and programs formulated in the study in the early and long term needs. The plan is summarized in figure K.

The proposed and additional projects in programs selected for the comprehensive plan were divided into two time phase categories based on the urgency of meeting present and projected needs. The first category, the early action plan, contained projects and programs which should be initiated within the next 10–15 years. Second, the long range plan includes those measures necessary to meet future water and land resource needs.

1/ Early action studies.

TABLE C

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM

No.	Project	Status 1/	Purpose 2/
	EARLY ACTION AND LONG RANGE STRUCTURAL MEASURES		
	EXISTING, UNDER CONSTRUCTION AND AUTHORIZED PROJECTS		
	Major Reservoir Projects		
1	Cagles Mill	C	F, R
2	Mansfield	C	F, R, Q
3	Monroe	C	F, R, M, Q
4	Salamonie	C,	F, R, Q
5	Mississinewa	C	F, R, Q
6	Huntington	C	F, R
7	Lafayette	A	F, R, FW
8	Big Pine	A	F, R, FW
9	Lincoln	A	F, R, FW, Q, M
10	Clifty Creek	A	F, R, FW
11	Patoka	U	F, R, FW, Q, M
12	Big Walnut	A	F, R, Q, M
13	Big Blue	A	F, R, Q, M
14	Downeyville	A	F, R, M
15	Louisville	A	F, R, Q, M
16	Helm	A	F, R, Q, M
	Levees and Local Protection Projects		
17	Brevoort	C	F
18	Gill Township	C	F
19	Lyford	C	F
20	Muncie	C	F
21	Levee Unit 8	C	F
22	Levee Unit 5	U	F
23	Terre Haute	C	F
24	Delphi	C	F
25	Vincennes	C	F
26	New Harmony Bridge	C	F
27	Niblack	C	F
28	Indianapolis	U	F
29	Anderson	A	F
30	Levee Unit 3	A	F
31	Levee Unit 1	A	F
32	Levee Unit 2	A	F
33	Levee Unit 3&4	A	F
34	Levee Unit 9	A	F
35	Levee Unit 10	A	F
36	Shoals	A	F
37	Sugar Creek	A	F
38	Russell & Allison	A	F
39	Levee Unit 6	A	F
40	Adams	A	F
41	Clinton, Indiana	A	F
42	Deer Creek Prairie	A	F
43	Honey Creek	A	F
44	West Terre Haute	U	F
45	England Pond	U	F
46	Greenfield Bayou	A	F
47	Island Levee	U	F
48	Rochester & McL Bluff	U	F
49	Tri-Pond	U	F
50	Bonpas Creek	A	F
51	Fletcher & Sunshine Gardens	A	F
52	Levee Unit 2	A	F
53	Levee Unit 1	A	F
54	Levee Unit 2	A	F
55	Levee Unit 1	A	F
56	Levee Unit 2	A	F
57	Levee Unit 1	A	F
58	Levee Unit 7	A	F
59	Levee Unit 17	A	F
60	McGinnis	A	F
61	New Harmony	A	F
62	Raccoon	A	F
63	Shufflebarger	A	F
64	Orleans	A	F
65	Mount Carmel	U	F
66	Marion	A	F
	Upstream Watershed Projects		
67	Elk Creek	C	F, I, FW
68	Boggs Creek	C	F
69	French Lick Cr	C	F, FW
70	Little Wea Creek	C	F
71	Upper Wabash	C	F
72	Rock Cr - Wells Co	A	F
73	Mill Cr - Fulton Co	A	F
74	Bachelor Run	A	F
75	Prairie Creek - Daviess Co.	A	F, R
76	Lattas Creek	A	F
77	Mill Creek	A	F, R
78	Indian Creek	A	F, R
79	Prides Creek	A	F, R
80	Stucker Fork	A	F
81	DeWitt Creek	A	F
82	Twin Rush Creek	A	F, M, R
83	Upper Big Blue River	A	F, M, Q, R
84	West Boggs Creek	A	F, R
85	Busseron Creek	A	F, M, R
86	Kickapoo Creek	A	F
87	Prairie Cr - Vigo Co	A	F
88	Little Raccoon Creek	A	F, R
89	Scattering Fork	A	F
90	Seven Mile Creek	A	F, R

TABLE C

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM (CONT'D)

RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN

No.	Project or Site	CNI No.	Purpose[2/]
Major Reservoir Projects			
1	Azalia		F, R, FW
2	Deputy		F, R, FW, Q
3	Parker		F, R, FW, Q
4	Fall Creek		F, R, FW, Q, M
5	Crawfordsville		F, R, FW, Q, M
6	Salt Fork		F, R, FW, Q
Levees and Local Protection Projects			
7	Levee Unit 2		F
8	Levee Unit 3		F
9	Levee Unit 4		F
10	Levee Unit 5		F
11	Patoka Channel Imp		F
12	Columbus West Levee		F
13	Wiemeyer Levee		F
14	Beatty Levee		F
15	Levee Unit 5		F
16	Levee Unit 17		F
17	Levee Unit 50		F
17a	Levee Unit 7		F,RG
17b	Levee Unit 8		F,RG
Upstream Watershed Projects			
18	Clear Creek	17-9	F, D
19	Little River	17-8	F, R, D
20	Buckeye-Hoosier	17-2-3	F, R, Q, D
21	Salamonie River	17-12	F, R, D
22	Pony Creek	17b-3	F, D
23	Lower Mississinewa River	17a-2	F, R, FW
24	Upper Mississinewa River	17a-1	F, D
25	Brown-Hill	17c-21	F, D
26	Big Monon Ditch	17c-20	F, D
27	House-Bartee	17c-9	F, D
28	Mud Creek	17c-7	F, D
29	Sugar Creek	17-39	F, D, FW
30	Rock Creek (Cass Co)	17-33	F, D
31	Burnetts Creek	17-31	F, D
32	Crooked Creek	17-31	F, D
33	Goose Creek	17-26	F, R
34	Veale Creek	17hl-49	F, R
35	Black Creek	17hl-45	F, R, Q, D
36	Lagoon Ditch Wabash & Erie Canal	17hla-14&16	F
37	Splunge Creek	17hla-13	
38	Birch Creek	17hla-11	F, Q
39	Jordon Creek	17hla-8	F, R
40	Croys Creek	17hla-6	F, R
41	Deer Creek	17hla-4	F, R
42	Little Walnut	17hla-2	F, R
43	Rattlesnake Creek	17hl-30	F, R
44	Bryant Creek	17hl-25	F, R
45	Whitelick Creek	17hl-20	F, R, Q
46	Killbuck Creek	17hl-3	F, D
47	Wilson Creek	17h-3	F, R, Q, M
48	Aikman Creek	17h2-45	F, D
49	Lost River	17h2-41	F, R, M
50	Upper Vernon Fork	17h2b-1	F, R, M, Q
51	Lower Vernon Fork	17h2b-2	F, R, D
52	Pond Creek	17h2b-7	F, R, D
53	Little Salt Creek	17h2-33	F
54	White Creek & Beatty Walker Ditch	17h2-15	F, R, D
55	Denios Creek	17h2-10	F, R
56	Lewis Creek	17h2-5	F, D
57	Upper Big Flat Rock River	17h2-1	F, M, FW, D
58	Delaney Creek	17h2b-8	F, I, R
59	Brandywine Creek	17h2a-4	F, D
60	Little Blue River	17h2a-3	F
61	Vieke Ditch	17-105	F, D
62	Raccoon Creek (Illinois)	17-107	F, D
63	City Ditch	17-103	F, D
64	Snapp-Kelso	17-103	F, R
65	Mariah Creek	17-102	F, R, D
66	Lower Shaker Prairie	17-101	F, D
67	Turtle Creek	17-93	F, I, R
68	Mill Creek (Illinois)	17-87	F, R
69	Snyder Creek (Illinois)	17-85	F
70	Honey Creek	17-77	F, R
71	Sugar Creek (Illinois)	17-75	F, R
72	Otter Creek	17-71	F, R
73	Coal Creek	17-55	F, R
74	Fall Creek	17-51	F, R
75	Feather Creek	17-68	F, R
76	Big Raccoon Creek	17-62	F, R, FW
77	Jordon Creek	17e-7	F, D
78	Lye Creek	17f-3	F, D
79	Brushy-Birch Creek	17g-3&4	F, R, Q
80	Muddy Creek	17g-5	F, D
81	N. F. Embarras River	17g-11	F, R, Q, M
82	Crooked Creek	17g-12	F, R
83	Muddy Creek	17g-21	F, R, M, Q
84	Brushy Creek	17g-33	F
85	Big Creek	17-125	F, R, D
86	Gresham Creek	17-121	F, R, D
87	McHenry-Hawthorne		

TABLE C

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM (CONT'D)

No.	Project or Site	CNI No.	Purpose 2/
88	Scott Ditch & Coffee Bayou	17-113	F, R, D
89	Bonpas Creek	17-117	F, R, Q, D
90	Lick Creek	17j-2	F, R
91	Auxier-Big Creek	17jl-12	F, R, M, D
92	Big Mound	17jl-14	F, D
93	Dry Fork	17jl-15	F, R, M
94	Horse Creek	17jl-18	F, R, M
95	Pond Creek	17j-28&29	F, R
96	Fox River	17j-39	F, R, M, Q
97	Big Muddy Creek	17j-42	F, R
98	Salt Creek	17j-51	F, R
99	Upper Little Wabash River	17j-52	F, Q, M
100	Hunley-Ell	17i-6	F, R, Q, M
101	Upper Patoka River Tributary	17i-3	F, Q, M
102	Hall-Flat Creek	17i-4	F, R, Q, M

RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN

Major Reservoir Projects

No.	Project or Site	CNI No.	Purpose
1	Maltersville		F, R, FW
2	Martinsville, Upper		F, R, FW
3	Deer Creek		F, R, FW
4	Denver		F, R, FW
5	Pipe Creek		F, R, FW
6	Delphi, Upper		F, R, FW
7	Coal Creek		F, R, FW

Levees and Local Protection Projects

No.	Project or Site	CNI No.	Purpose
7a	Levee Unit 3		F,RG
7b	Levee Unit 9		F,RG

Upstream Watershed Projects

No.	Project or Site	CNI No.	Purpose
8	Scuffle Creek	17-14	F, D
9	Eel River	17b-1	F
10	Timmons Ditch	17c-19	F, D
11	Ackerman Ditch	17c-18	F, D
12	Quigley Marsh Ditch	17c-11	F, D
13	Fell-Taylor Ditch	17c-9	F, D
14	Chapman Creek	17c-8	F, D
15	South Fork Wildcat Creek	17d-2	F, D
16	Deer Creek	17-36	F, D
17	Pleasant Run Creek	17-34	F, D
18	Rattlesnake Creek	17-34	F, D
19	Doans Creek	17hl-40	F, R
20	Kick Creek	17hla-17	F, R
21	Pond Creek	17hla-15	F
22	Six Mile Creek	17hla-10	F, R
23	Hog-McIntyre	17hla-7&9	F, R
24	Fish Creek	17hl-32	F, R
25	Burkhart Creek	17hl-24	F, R
26	Clear Creek	17hl-19	F, R
27	Pipe Creek	17hl-5	
28	Sugar & Slate Creek	17h2-40	F, R
29	Sulphur Creek	17h2-34	F, R
30	Gutherie	17h2-24	F, R, M
31	Buffalo Creek	17h2-20	F, R
32	McHargue Ditch	17h2-17	F, D
33	John Thompson Ditch	17h2-13	F
34	Big Slough	17h2-6	F
35	Youngs Creek	17h2-6	F
36	Bear Creek	17h2-44	F, R
37	Crawfish Creek	17-110	F, D
38	Turman Creek	17-91	F
39	Raccoon Creek (Illinois)	17-88	F, R
40	Big Creek (Illinois)	17-82	F, R
41	Clear Creek (Illinois)	17-76	F, R
42	Lost Creek	17-73	F
43	Norton Creek	17-68	F, R
44	Big Shawnee Creek	17-52	F, D
45	Cole Branch	17e-3	F
46	Stony Creek (Illinois)	17e-11	F, D
47	Sugar Mill	17f-10	F, R
48	Little Sugar Creek	17f-5	F, D
49	Otter-Beaver-Allison	17g-2, 36&37	F, D
50	Honey Creek	17g-7	F, R
51	Range Creek	17g-20	F, R
52	Hurricane Creek	17g-23	F
53	Black River	17-120	F, R
54	French Creek	17-118	F, R
55	Limekiln Creek	17jl-6	F, D
56	Lost Creek	17jl-8	F
57	Beaver Creek	17jl-9	F
58	Prairie Creek	17jl-10	F, D
59	Nameless Creek	17jl-11	F, M
60	Brush Creek	17jl-21	F
61	Elliott Creek	17j-24	F
62	Big Creek	17j-27	F
63	Elm River	17j-34	F, R
64	Panther Creek	17j-44	F
65	Crooked Creek	17j-45	F
66	Dismal Creek	17j-46	F
67	Bishop Creek	17j-50	F, M
68	Flat Creek	17i-12	F, M
69	Cup Creek	17i-9	F, R, M

TABLE C

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM (CONT'D)

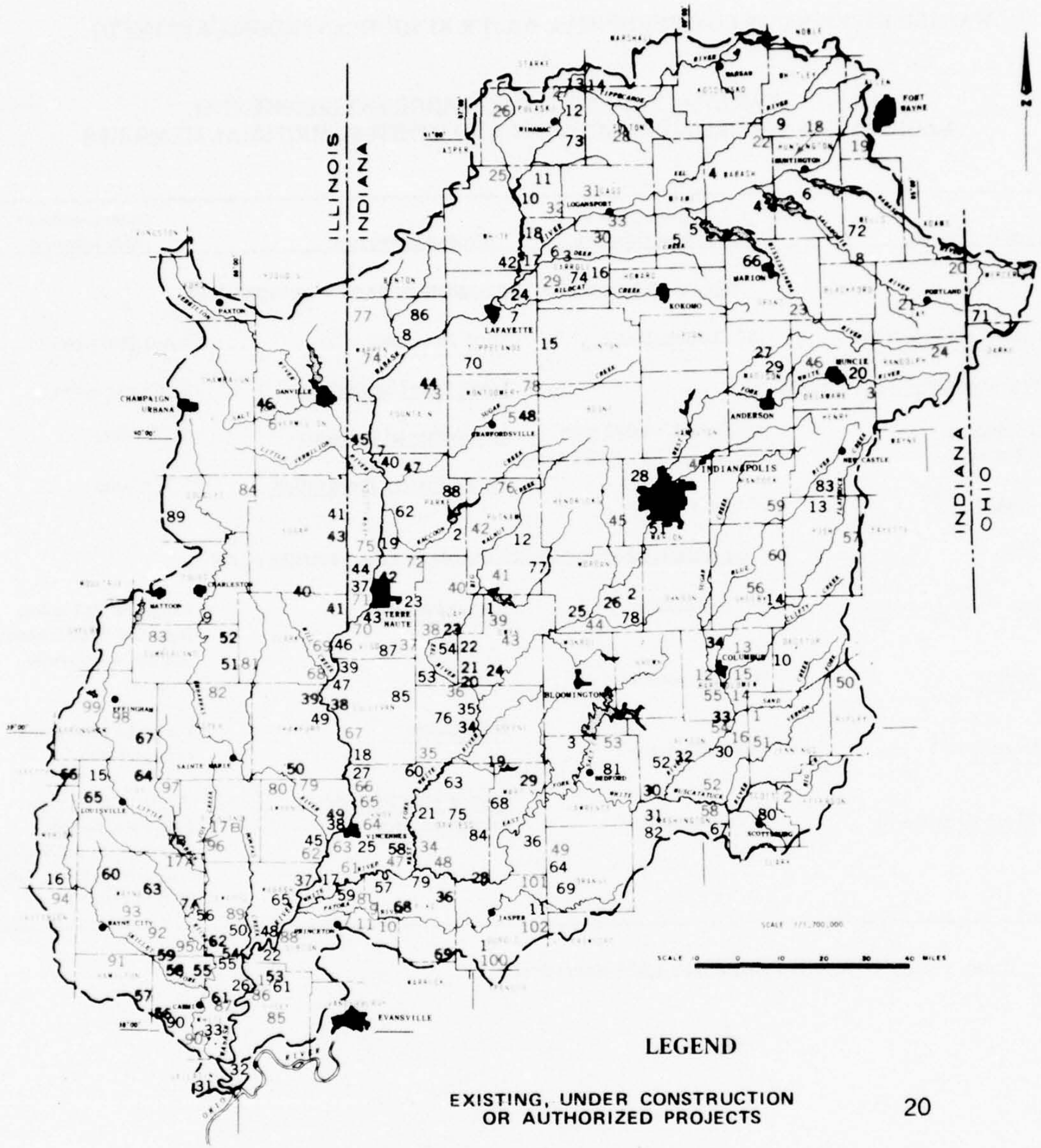
EARLY ACTION AND LONG RANGE ENVIRONMENTAL, REGIONAL AND SOCIAL–MANAGEMENT AND OTHER STRUCTURAL MEASURES

Project or Program	Communities or Area Involved	Project or Program	Communities or Area Involved
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN			
Advanced Waste Treatment	112 Communities	Land Treatment	8,461,000 Acres
Coal Mine Drainage Pollution Abatement		Flood Plain Management	54 Communities
Patoka Subbasin	South Fork - 4,000 acres	Environmental Corridors	1,673 Miles
Middle Wabash	Busseron Creek - 1,920 Acres	Stream Fishery Preservation	3,259 Miles
Water Supply	69 Communities		
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN			
Advanced Waste Treatment	64 Communities	Wabash Parkway	Length of 212 miles; from Old Shawneetown, Illinois to Lafayette, Indiana
Water Supply	190 Communities		
		Trail System	Would be built along with parkway.
Land Treatment	5,088,000 Acres		
Flood PLain Management	61 Communities	Hoosier Lake National Recreation Area	Would be located in Lawrence, Orange, Washington, and Jackson Counties, Indiana - involve 67,000 acres.

Note: Stream Fishery Preservation should read 1,604 access sites.

1/ C - Constructed; U - Under Construction; A - Authorized.

2/ F - Flood Prevention; M - Municipal and Industrial Water Supply; Q - Water Quality Control; I - Irrigation; R - Recreation; FW - Fish and Wildlife; D - Drainage; RG - Regional.



LEGEND

EXISTING, UNDER CONSTRUCTION OR AUTHORIZED PROJECTS	20
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WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM

FIGURE K

COMPREHENSIVE BASIN STUDY
ON
WABASH RIVER, ILLINOIS, INDIANA AND OHIO

MAIN REPORT

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WABASH RIVER
– NEAR THE MOUTH

SECTION I – INTRODUCTION

BACKGROUND

General

The Wabash River has played an important role in the history of our nation. It was used extensively as a trade route by the Indians; by the French and English explorers and traders; by the early settlers of the American colonies; and today, it still is a vital resource – an element of vitality in the environment of the midwest.

The Wabash River Comprehensive Study includes this Main Report and thirteen appendices which contain the specific studies and reports relating to the problems, needs and proposals for the basin. The study deals with the water resources and land problems related to flood control, water supply, water quality control, outdoor recreation, fish and wildlife, irrigation, hydroelectric power, drainage, watershed and land management and land stabilization. In all of these problem areas of our human environment, the preservation of our natural environment – natural beauty, aesthetic values, biotic communities, ecosystems – has been an ever present goal and a formal consideration in the final formulation of the comprehensive plan.

This introductory section presents an informative background to the report. It briefly describes the settlement of the basin to the present time, study objectives, authorization for the investigation, study scope, organization and procedures.

Historical Setting

From the initial appearance of French explorers, fur traders and missionaries during the last half of the 17th century to the present, geographical factors have been fundamentally important to the Wabash River basin. These factors include unusually fertile soil, a favorable climate, a variety of mineral wealth and its strategic location as a divide between the great river basin of the Mississippi and St. Lawrence – a crossroads of America.

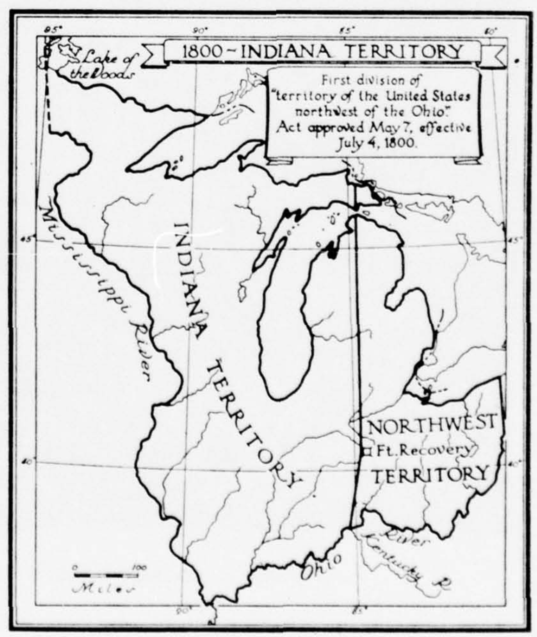


FIGURE 2. **HISTORICAL MAP**

During the 16th and 17th centuries, the St. Lawrence River area gradually became known as new France. It was during this period that the French began to penetrate the area south of the Great Lakes. Near the end of the 17th century, Frenchmen paddled up the Maumee River from Lake Erie to where Ft. Wayne, Indiana now stands. From here, it is only a short distance to the Little River which soon flows into the main channel of the Wabash. The Maumee-Wabash route became a superwaterway during the days of the French for travel through Indiana and Illinois.

About 1719 the French established a small outpost at Quiatanon on the Wabash River near the later city of Lafayette, Indiana. By early 1730, they added an outpost at Vincennes on the lower Wabash. Even before the French had established a trading outpost in the Wabash Basin, a duel for power on the continent of North America had commenced with the English. During the period 1689 to 1763, the years of conflict were interspersed with periods of peace; the last French and Indian War, 1754-1763, ended in the triumph of the English, in the expulsion of the French from the mainland of America. For two decades, 1763-1783, the Wabash Basin continued under the English. During this period the English, aided by Indians and Tories, mounted various raids and small campaigns against colonists in the Ohio Valley to placate the Indians and in part delay and restrict the advance of western settlement. In return, from the south of the Ohio River, opposing raids and campaigns were thrust against the English by the Virginia and Kentucky settlers under the leadership of George Rogers Clark. The extent to which Clark's campaign of 1778-1779 contributed to the winning of the west for America is still a question, but knowledge of Clark's campaign reached the men who negotiated the treaty ending the Revolutionary War, setting the southern boundary of Canada at the Great Lakes for all time.

The War of 1812 brought many severe hardships to the settlers of the Wabash from its outbreak in June of 1812. In December, the Battle of Mississinewa, fought a short distance northwest of the present city of Marion, Indiana, punished the Miami Indians for participating in the

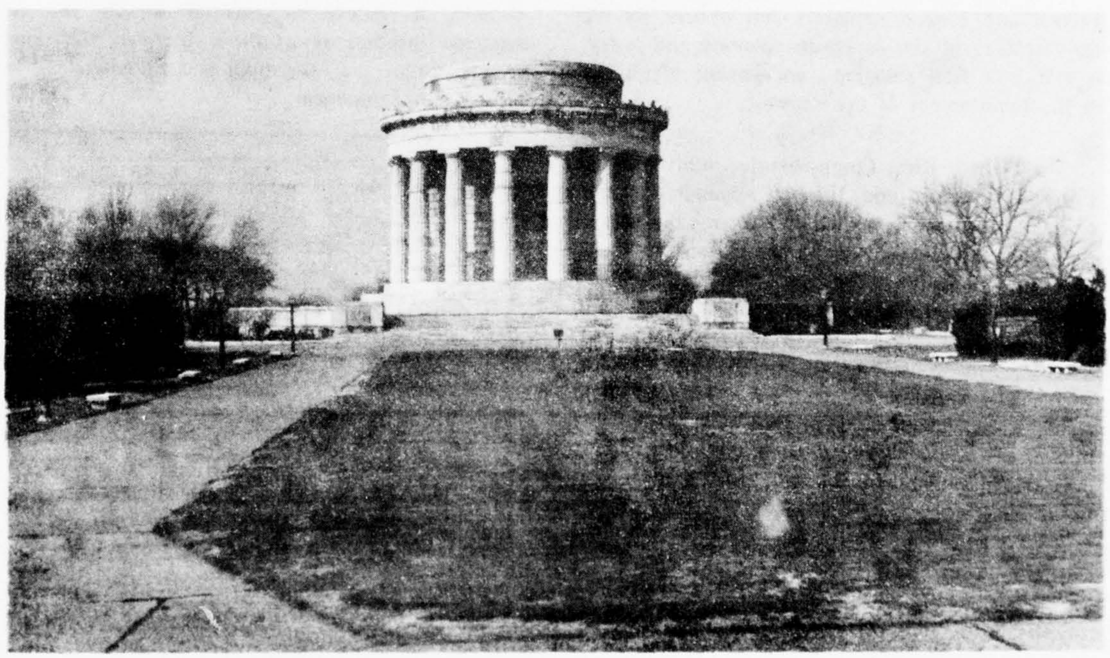


FIGURE 3. GEORGE ROGERS CLARK MEMORIAL, VINCENNES, INDIANA

attack against Fort Wayne, but it was not considered a major battle. The war ended with the Treaty of Ghent in 1814 – the Indians had been crushed; Tecumseh, a unifying force among the Indians, was killed at the Battle of the Thames; British influence in the Old Northwest had been permanently weakened; and a principal deterrent to settlement of the Wabash Basin and the entire western frontier country had been removed. A more detailed treatise is given in Appendix I – Environmental Resources.

Wabash River Today

In spite of his early dependence on the river, man has been lax in managing and conserving this precious resource. He has allowed rainfall to flow uncontrolled from the land to the sea, ravaging his cities and his farms on the way. He has carelessly allowed his streams and lakes to become contaminated with waste to the point where their waters endanger his own survival. In short, he has not measured up to his responsibilities for stewardship.

In the beginning, this difference mattered little. Water was plentiful and soil was expendable. Floods could be accepted as inevitable because there was relatively little of value for them to destroy. Today, as the world moves towards the end of the 20th century, indifference has changed to serious concern. There is hardly a country or an area on the face of the earth that is not faced with critical problems in the conservation of water and related land resources. Indeed, in many cases, the solution of these problems may well be the key to future growth or even survival.

In this respect the Wabash River valley is no exception. Until recently, the plentiful rains of the valley have fallen and run off with no control, carrying with them valuable and irreplaceable soil. Until recently human and industrial wastes have been poured into streams at an ever increasing rate, destroying fish and wildlife habitat, limiting recreation, and threatening human health. Many communities have suffered intolerable flood damage only to find themselves confronted a few months later with water shortages of an equally damaging character.

Fortunately, the people of the Wabash Valley began to recognize the seriousness of their water problems, before they were overwhelmed by them. In 1946, the first major reservoir in the basin was funded by Congress for construction and this project came into operation in 1953. Since that day five additional major multipurpose reservoirs have been completed. Since the enactment of Public Law 566, small watershed projects have been planned and administered by the Soil Conservation Service. In addition, Federally-sponsored local protection projects have been authorized, several have been completed or are under construction, and others are expected to be started in the immediate future. An important step was taken by the people of the valley in 1962, when, acting through their authorized representatives in the United States Congress, they obtained financial support for a comprehensive study of water and related land resources of the basin to serve as a basis for future conservation and development. The findings of this study, which, in the opinion of many, are vital to the future well-being of the valley, are the subject of this report.

OBJECTIVES OF INVESTIGATION

Policy Objectives

The objectives of this report are a testimonial to the increasing concern of all Americans about their environment. At the beginning of the investigation, the work plan reflected the planning policies of the day, those which are stated in a report by the Secretaries of the Interior, Agriculture, Army, and Health, Education and Welfare – "Policies, Standards, and Procedures in the Formulation, Evaluation and Review of Plans or Use Development of Water and Related Land Resources" – dated 15 May 1962. The final objectives of the investigation have been broadened as an attempt to encompass the intent of the Congress in several major enactments along with the well being objectives as the people of the 1970's understand them. Thus, the study has been transformed from the primary single-objective approach to one that involves the four primary objectives related in the following paragraphs.

National Income Objectives

National income measures the nation's output as the sum of income earned by owners of the various factors of production involving labor and property which arise from current and future production. The increase in national income attributable to a project or plan results from the provision of water supplies and water quality control for domestic, municipal, agricultural and industrial uses; navigation facilities; electric power; flood control; agricultural improvements and general recreation.

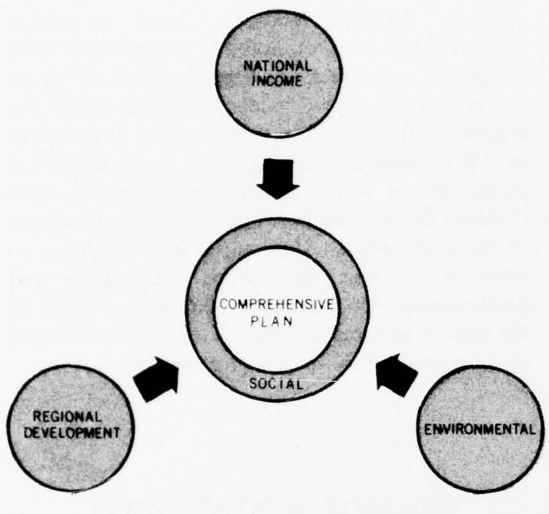


FIGURE 4. OBJECTIVES OF INVESTIGATION

Regional Development Objectives

The regional objectives embrace a matrix of interrelated components affecting a specific region – in our case, the Wabash River basin. These components involve: (1) increased regional income, (2) increased regional employment, (3) improved economic base, (4) improved income distribution within the region, and (5) improved quality of services within the region. No one of these items can be singied out as dominant and solely responsible for regional development.

Environmental Objectives

Environmental objectives are perhaps the most difficult of all to define as they take into account the ecology of man, our quality of life, the beauty of flowing rivers, wildlife, pastoral valleys, soil, spacious plains, majestic forests, archeological and scientific areas, and man himself. The approach to these objectives which considers the ecology of man seems to hold the most hope for success and is allied to the following guidelines: (1) the preservation and enhancement of aesthetic areas; (2) the protection of areas of archeological, historical or scientific value; (3) protection or improvement of water quality from all forms of waste, detrimental runoff and thermal pollution; and (4) land and forest protection or restoration.

Social Objectives

The preamble of the Constitution of the United States – "We, the people of the United States, in order to form a more perfect union, establish justice, insure domestic tranquility, provide for the common defense, promote the general welfare, and secure the blessings of liberty to ourselves and our posterity, do ordain and establish this Constitution for the United States of America" – furnishes the intent of our Founding Fathers. In water resources planning the well-being or social objectives examine personal, group and community effects of project proposals. The security of life and health, national defense, population and employment distribution are but a few of the concerns of this policy objective.

Study Objective

To achieve all of these broad objectives, a number of specific objectives and guidelines were required. The detailed application of these is presented in the individual appendices to this report. The procedure used in developing a coordinated comprehensive plan is summarily described as including a resource inventory, an inventory of early and long-range needs, an examination of alternative ways of meeting these needs, and proposals of projects and programs that would meet these requirements. The specific objectives and guidelines adopted to govern the study and report follow.

a. Determine the demands that will be placed upon water resources for early action and long range. Early action and long range are defined later in paragraph d which follows.

b. Articulate the problems that will accrue to the several areas, namely: municipal and industrial water supply, water quality control, flood control, irrigation, drainage, recreation, preservation, and enhancement of the fish and wildlife resources, cooling water for electric power plants, protection and preservation of the water courses related to the natural environment, historical and archaeological areas of significance, and to aid in improving the general welfare of the region.

c. Identify the alternatives for meeting the demands that may be placed on the water resources of the area.

d. For each of the eight hydrologic subbasins, determine the most economically efficient means of meeting the demands; thus develop a national income efficiency plan of water resources development in each of the subbasins. These plans will consist of the 1968 Going Program incorporating those projects which functioned on 31 December 1968 and the following:

(1) Present plan consists of the projects in the 1968 Going Program and projects and programs which are authorized.

(2) Early action plan includes those projects in the present plan which are presently authorized and likely to be built by 1980 plus those original projects which exhibit economic feasibility, and will be needed to meet the 1980 demand and

(3) Long range plan adds to the early action plan those additional projects which will be needed to meet the 2020 demands. The long range plan will be developed in somewhat less refinement than the early action plan.

e. Determine if modifications are required in the Early Action and Long-Range Plans to better stimulate economic and social objectives of the several regions within the basin.

f. Determine if modifications are required in the Early Action and Long-Range Plans in the interest of preservation and enhancement of the environment.

g. Determine how the plans developed in 'f' above affects the land and resources capabilities of the basin.

h. Determine how the plan developed in 'f' above affects the tax base of the political subdivisions in the area.

i. Determine if there are areas within the Basin that had the attributes of a National Recreation Area.

j. It will be recognized that authorizing reports will be required to support potential programs and projects for Congressional authorization.

k. Recommendations will be made for periodic review of the comprehensive plan.

AUTHORIZATIONS FOR THE INVESTIGATION

Since the first comprehensive flood control plan was reported in 1932, extensive changes have taken place in almost every characteristic of the area. Rural communities have grown into marketing centers; the population has increased 50 percent since 1930; and total employment is up over 75 percent. Accordingly, in 1962 the people of the valley, through their elected representatives, requested that the Congressional resolutions concerning water and related land resources in the basin be combined to assure a complete unification of all Federal and State planning for the orderly development of projects and programs. Prior to this interest of local people, the Wabash had been proposed for a comprehensive study in recommendation No. 1 of the Senate Select Committee on National Water Resources in its report of January 1961. The recommendation states:

> "The Federal Government, in cooperation with the States, should prepare and keep up-to-date plans for comprehensive water development and management for all major river basins of the United States . . ."

To coordinate this program, the Water Resources Council was established. Members of the Council include the Secretary of Agriculture, Secretary of the Army, Secretary of Health, Education and Welfare, Secretary of Interior, Secretary of Transportation, and the Chairman of the Federal Power Commission. The program,

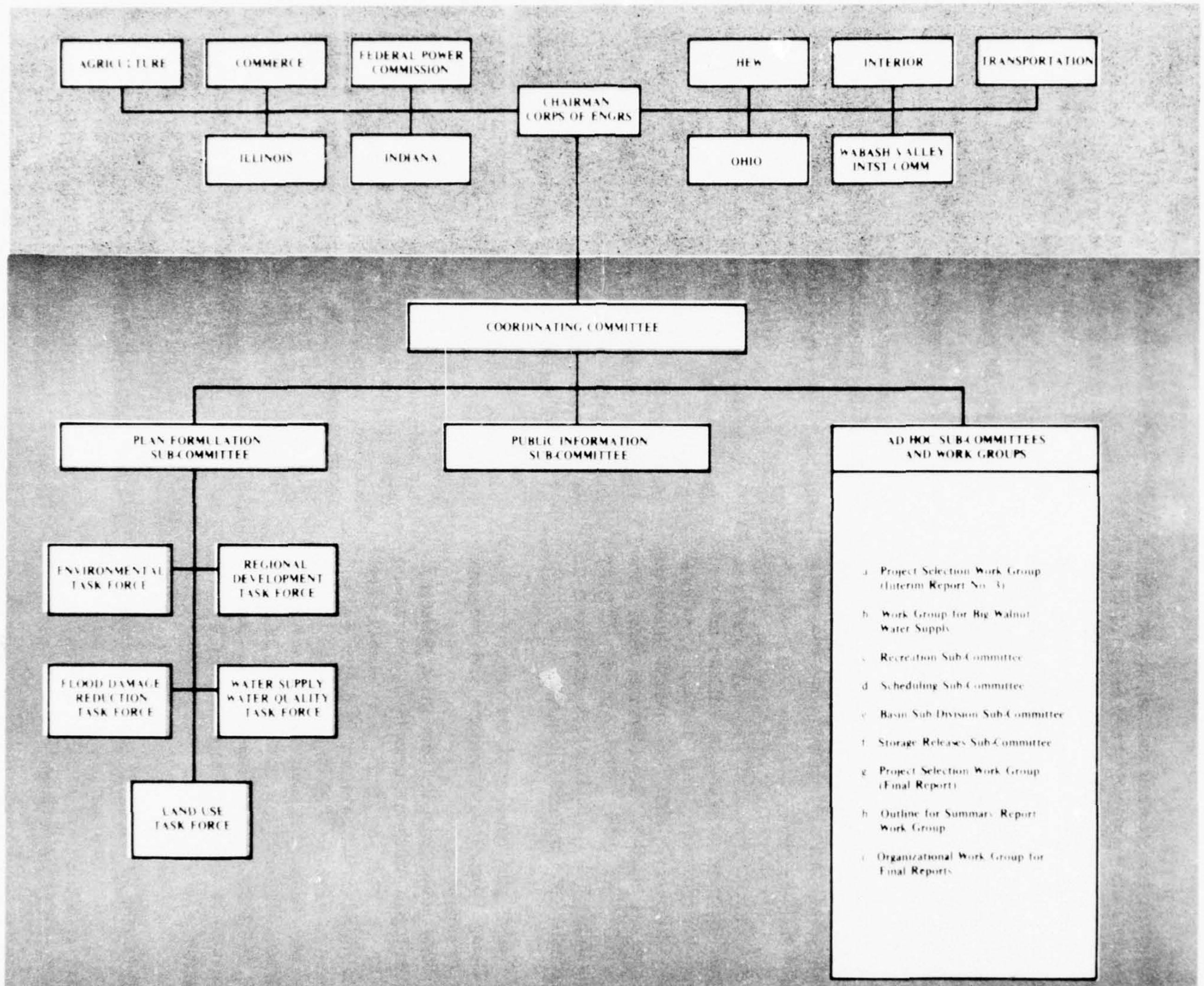


FIGURE 5. ORGANIZATIONAL CHART WABASH COMPREHENSIVE STUDY

which has been approved and partially funded by Congress, provides for a group of frame work studies covering major river basins and a group of detailed comprehensive studies to provide a basis for authorization of specific projects. The Wabash River basin is one of those included in the program for a detailed comprehensive study.

There are thirty-four separate Congressional resolutions outstanding which request study of all or portions of the Wabash River basin. These resolutions along with the foregoing program constitute the authority for a comprehensive study of the Wabash River basin. The broadest of the resolutions is as follows:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE That the Board of Engineers for Rivers and Harbors, created under Section 3, of the Rivers and Harbors Act, approved 13 June 1902, be, and is hereby requested to review the reports of the Chief of Engineers on the Wabash River and tributaries, Illinois and Indiana, submitted as House Document 100, Seventy-third Congress, First Session and other reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time in the interest of flood control and the development and conservation of water and related land resources of the basin." (Adopted: 6 May 1958).

In early partial responses to the above authorities, three interim reports have been prepared by the Wabash Coordinating Committee. These reports have resulted in Congressional authorization of construction for ten multipurpose reservoir projects and one local protection project. The reservoir projects include Lincoln, Louisville and Helm in Illinois; and Lafayette, Big Pine, Clifty Creek, Big Walnut, Patoka, Big Blue and Downeyville in Indiana. The local flood protection project would afford flood protection at Marion, Indiana.

Studies of participating agencies were conducted under authority of the Water Resources Planning Act of 1965 and the following major laws, amendments, and resolutions:

Flood Control Acts of 1928, 1936, 1938, and 1944.

River and Harbor Act of 1946

Thirty-two separate Congressional Resolutions

Federal Water Power Act of 1920, as amended.

Federal Power Act of 1935, as amended.

Fish and Wildlife Act of 1934, as amended.

Park, Parkway and Recreational Area Study Act of 1936.

Outdoor Recreation Act of 1963.

Transportation Act of 1966.

Watershed Protection and Flood Protection Act of 1956.

Federal Water Pollution Control Act of 1956.

Water Supply Act of 1958.

A summary of all laws and resolutions pertaining fully to this investigation are contained in the documented history of this report, Appendix A – History of Study.

ORGANIZATION

General

It was apparent that to carry out the intent of the Congress indicated in the foregoing resolutions and other authorities, that the Corps of Engineers charged with the responsibility for coordination of the study, would have to call upon and work closely with all Federal, State and local agencies involved in the water and land resources of the basin. Public meetings and hearings; meetings within and between the Federal agencies and states involved and other actions in conformity with the need for coordination were initiated early in the study. Organization of a coordinating committee and its sub-committees and work groups is the subject of the following paragraphs; figure 5 illustrates the collaborating relationship and flow of the study organization.

Coordinating Committee

In 1963 the coordination of the Study was formalized to establish broad guidance and general direction. Thus, the Wabash River Basin Comprehensive Committee was formed under the permanent chairmanship of the District Engineer, Louisville District, Corps of Engineers, Department of the Army. The membership comprised representatives of the Departments of Agriculture, Army, Commerce, Health, Education and Welfare, Interior, Transportation, and the Federal Power Commission, Wabash Valley Interstate Commission and the States of Illinois, Indiana, and Ohio.

The Committee provided a forum for a full exchange of views coordinating all portions of the work carried on by the individual Federal and State agencies. In providing this guidance, decisions and policies were established consistent with existing water resource policy, related legislation and prior enactments under which the respective agencies operate. The activities of the Committee included but were not limited to establishment of policy for coordination of study efforts; assisted in resolution of study problems and conflicts; a periodic review of progress; the provision of information to the public; and consideration of a report from all participants. An initial meeting was held in December 1963. Subsequent meetings were scheduled as necessary to assure study progress, on the average of about every three months. From the initial meeting through July 1970, twenty-seven meetings were held. A detailed account of the Coordinating Committee is given in Appendix A, History of Study.

Subcommittees and Work Groups

Throughout the course of the study, various groups were formed by the Coordinating Committee, as necessary, for conducting certain phases. A full treatment of each group is given in Appendix A – History of Study. Member agencies of the subcommittee's Ad Hoc Work Groups were those agencies which had special interests or responsibility for accomplishing a particular part of the study. The chair agency was generally that agency which is normally responsible for conducting the work involved under existing legislation. Responsibilities of the Chair include overall coordination among member agencies; establishment of criteria; development of work schedules; and initial preparation of the group report. The members of the groups assisted the Chair in all of the aforementioned activities and furnished data as directed for accomplishment of the final result.

STUDY SCOPE
PLANNING ASSUMPTIONS
AND CRITERIA

Study Scope

The Wabash Basin has contributed much to the economic, social and political well-being of the mid-West, indeed the nation. Water, which is fundamental to all human needs, is abundant in the valley. Of course, the water is not uniformly available in time, place or quality. To gain a proper perspective of the requirements that will be placed on this precious resource and related resources in the future, to plan for their continued beneficial use, this has been the task of this investigation. The accomplishment of this task requires an inventory of the past and present resources of water, predictions of future needs and an understanding of the many-faced socio-economic, institutional and legal implications for the supply and use of water. This report gives an official account of these investigations.

The Comprehensive Plan, its features, functions, and scale, required many disciplines to assure an optimum plan; such a plan is essential to the proper development of human resources and the wise development of natural resources. The plan, thus defined, provides for control of the uneven flows of the Wabash streams to the extent practical and at the same time maintain the options that will insure the future social and economic strength of the area. The ultimate value of the plan is a guide for management and development of the water and related land resources of the basin – the Early Action Program to meet the most critical needs and the Long Range Program to meet the long range needs.

The 33,100 square mile geographical area encompassed by the Wabash River Comprehensive Study includes eight distinct hydrologic subareas: the Patoka, East Fork White, West Fork White, Upper Wabash, Lower Wabash, Middle Wabash, Embarras, and Little Wabash. Largest of the subbasins is the Upper Wabash River with a

drainage area of 7,267 square miles. The river is about 475 miles long from its confluence with the Ohio River to the head waters near Celina, Ohio. The Basin's length extends some 285 miles from the Ohio River to the northern most point which is approximately twenty miles south of the northern boundary of Indiana; its width is about 190 miles.

Planning Assumptions

Basic to intelligent and lasting plans are well-chosen assumptions and criteria for assurance that a balance of harmony, proportion and vitality are incorporated in the planning concepts. Man brought with him to this life not only a promise of high order of existence, but a threat that he may win from the earth a hollow victory that is short-lived, perhaps destructive to himself.

The broad comprehensive nature of this investigation required, for purposes of practicality, a number of basic assumptions. The broadest of these assumptions are: First, that the nation is in a period of relative stability with no widespread hostilities; second, that during the period of both the Early Action and Long-Range Plans to the year 2020, the Federal, State and local interests in water resource development were assumed to remain unchanged. Assumptions falling into a general category applicable to many of the study inputs are discussed in the following sub-paragraphs. Assumptions which are limited to a particular subject are related in appendix material.

Market Area: The market area for the products and services of water resource development in the Wabash River basin is generally limited to the basin, the outer limits of which are defined by the parochial counties. However, where the market is mobile, as in the case of outdoor recreation or the products or services are readily transportable, as in the case of electric power, adjustments were made in the market area to reflect the actual area presently being served or anticipated to be served under practical constraints.

Related Lands: The related lands under consideration in the study area are defined in the Water Resources Council Guidelines. Under that definition, related lands are those lands directly associated with water resource development either through significant effects of the land on the water resources or significant effects of the water resources and their development features on the land. Consequently, in connection with studies in this program, related land is that land on which projected use and/or management practices may significantly affect the runoff pattern or quality of the water resource to which it relates and land that is significantly affected by existing or proposed measures for the management, development or use of the water resource to which it relates.

Import and Export of Water: Consideration of import and export of water to and from the basin were limited to existing situations and to the provision of existing agreements. However, there were no study limitations regarding the interchange of water between subbasins.

Economic Projections: The projections of economic indices involved a number of assumptions. For example, population for the basin was projected by attributing to the basin a future share, based on established trends, of national population growth as estimated by application of the U. S. Census Bureau's Series C, moderate growth rate. The detailed constraints involved in these projections are documented in Appendix B – Economic Base Study.

Water Quality: The framework plan was founded on the equivalent of secondary treatment and disinfection of municipal and industrial wastes. If removal of 90 percent of five day, 20°C, biochemical oxygen demand was not sufficient to permit meeting established stream water quality standards, consideration was given to advanced waste treatment, low flow augmentation, and other alternatives.

Price Level versus Needs: In assessing the needs for the various products and services, no refinements were made to reflect the impacts of price levels. Also, the use of pricing techniques in connection with the use and management of resources was not considered.

Technological Advances: Future advances in technology were taken into account for projections for municipal and industrial water supply and waste loads for the Early Action and Long Range Plans.

Degree of Satisfaction: The Comprehensive Plan was based on a high degree of satisfaction relative

to the needs for the products and services of studies. This permits a significant amount of flexibility to be retained in the plan with respect to both the timing of investment and geographic distribution of development actions.

Project Potentials: It was assumed that the full potentials of the existing projects and all elements of the 1968 going program would be utilized to meet some of the growing needs of the basin. It was further assumed that these potentials would be fully considered in detail agency authorization reports.

Price Levels: Price levels prevailing in January 1968 were used for evaluating the present and future benefits and costs; projected long term prices were used initially at least insofar as Soil Conservation Service studies were concerned, and the final evaluations were based on adjusted normalized prices.

Interest Rate: An interest rate of 4-7/8 percent was used in analyzing cost and benefits in project formulation.

Project Life: The period of evaluation of the studies was the estimated economic life of each project or 100 years, whichever was less.

Benefits: To satisfy the human environment, the human needs and desires – this is the aim of water resource projects and programs. Physical capital goods and services are produced to achieve this goal. These goods and services have value in accordance with demand for them and their relative scarcity. Thus the benefits in this report represent the estimated increase in value of goods and services of a project expected for a period under study from which losses if any have been deducted. The precise definition of the individual categories of benefits are presented in the respective appendices.

STUDY PROCEDURES

Study Approach

The first imperative of a water resource program at any level is a vision to the future, a specific statement of goals, and a plan of action. For the Wabash River Comprehensive Study, the initial questions were: Where are the needs? Who should be involved? What are the possible solutions?

To adequately respond to these questions and many more, a plan of survey contemplated a complete investigation of needs and potentials for development of all purposes of water and related land resources in the formulation of a detailed framework plan involving both early action and long-range timing. A determination of the needs and potentials to serve the comprehensive objectives require participation by Federal and State agencies whose inherent interests and responsibilities were involved. These agencies cooperated with the Wabash River Coordinating Committee in the formulation and evaluation of plans of improvement to the extent their respective interests were affected.

Phasing of the study was initially directed to the early identification of existing and early action needs along with the formulation of feasible plans of improvements, compatible with the comprehensive basin development concept, to meet these needs. The results of this phase of the study was reflected in Interim Reports which were prepared in full survey scope to comprise a basis for Congressional authorization of the reported projects. Three such reports, recommending ten multipurpose reservoirs and one local flood protection project were completed.

The final phase of the study proceeded concurrently and in conjunction with the studies necessary for Interim Reports. In this phase all the needs, early action and long-range, were determined, and feasible plans of improvement formulated. The final stages constituted a wrap-up of all participating agency investigations aimed at a comprehensive plan. Projects authorized on the basis of previous investigation and in interim reports, but not constructed, were reviewed to assure economic feasibility and engineering compatibility with the national income efficiency plan which was defined in the study objectives. Modifications were made to the national income efficiency plans for each of the subbasins for reasons of regional development, environmental and social constraints – the results are the Wabash River Basin Comprehensive Plan presented in Section 7 of this report. A summation of the study approach is given in figure 6.

Report Composition and Assignments

The report summarizes the results of studies of participating agencies and presents a framework plan of comprehensive development of water and related land resources in the Wabash River basin. It also presents a review of needs and description of the plan and discusses steps necessary for implementation. The report is supported by thirteen appendices. The functional appendices primarily reflect the programs of the agency with primary responsibility for their preparation. The appendices, the general coverage, and the agencies assigned leadership for their preparation are listed below.

Appendix A: History of Study, prepared under the leadership of the Corps of Engineers, documents the events associated with the study. The appendix material is presented in four parts, the last part being an attachment. The first section is concerned with the content of appendix material. The second and third sections are a digest of events including past water resource developments through the present study. Attachment A contains the minutes of each of the Coordinating Committee meetings.

Appendix B: Economic Base Study, presents investigations which were designed for use by the agencies as a basis for establishing demands on water and related land resources. The appendix reports the results of simulation of the probable economic growth of the Wabash River basin and the interrelationship of the seasonal and national economy for a 50-year period. This appendix was prepared by the Corps of Engineers in coordination with cooperating agencies.

Appendix C: Plan Formulation, prepared under the leadership of the Corps of Engineers, presents summary findings of the various participating Federal and State agencies and integrates the inventories of needs and resources into a comprehensive plan within a matrix of study objectives.

Appendix D: Flood Control, prepared under the leadership of the Corps of Engineers, presents results of investigations of the Basin's flood problems and solutions for flood damage reduction.

Appendix E: Hydraulics, prepared under the leadership of the Corps of Engineers, presents

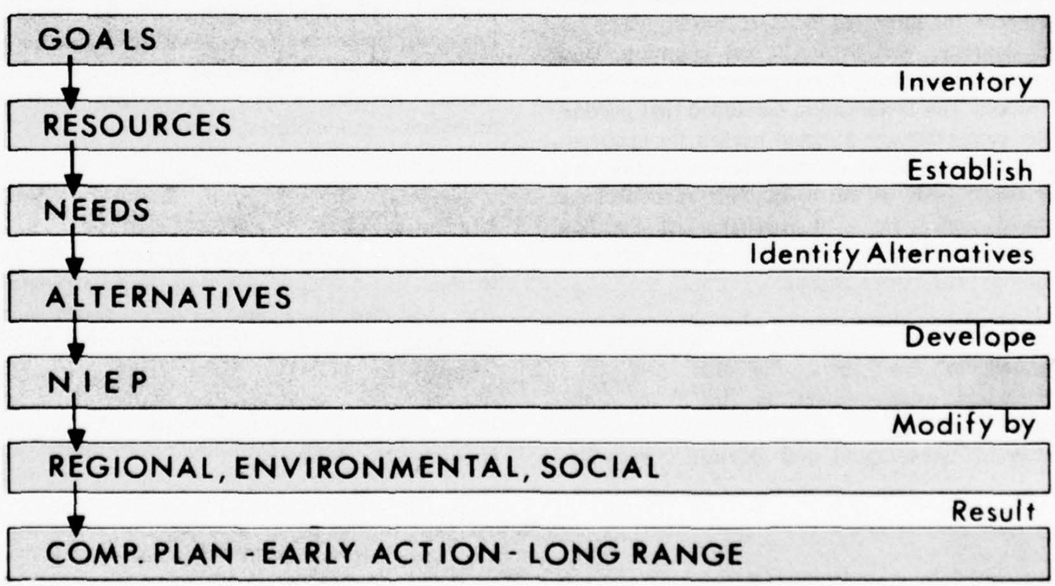


FIGURE 6 STUDY APPROACH

summaries of basic water resource data compiled in connection with the work for the major reservoirs and small watershed projects. It contains arrangements of these data into useful arrays necessary for analyses of water problems. The principal basic studies and basin hydrology characteristics which are treated include water availability; form types; previous storms and floods; low flow and flood flow frequencies; and reservoir studies.

Appendix F: Water Use and Stream Quality Control, prepared under the leadership of the Federal Water Quality Control Administration, (now incorporated into Environmental Protection Agency) presents determinations of present and future needs for municipal and industrial water supply and for water pollution control and examines problems and makes recommendations as to their solutions.

Appendix G: Ground Water, prepared under the leadership of the U. S. Geological Survey, presents a reconnaissance evaluation of the ground water resources based upon published and unpublished information of the geology and hydrology of the Wabash River basin.

Appendix H: Agriculture, includes projections and needs for agricultural output, timber production, land use, land treatment and management, as well as employment on farms and in timber based manufacturing industries. The report translates these into needs for improved drainage, water needs for rural domestic use, livestock and irrigation, land treatment, recreation, flood prevention and flood protection. The investigation developed that portion of the comprehensive program needed for upstream watershed development to meet the early action and long range needs of the basin. This appendix was prepared under the joint leadership of the Soil Conservation Service, the Economic Research Service and the Forest Service.

Appendix I: Environmental Resources is presented in four parts; the first part is a compendium which integrates the latter three portions on Recreation; Fish and Wildlife; and the Historical, Archeological and Scientific. Basically, the appendix comprises an inventory of resources and programs and it determines present and projected needs that can be satisfied by water and related land resources development. Preparation of the report material was under the direction of the Bureau of Outdoor Recreation, the Bureau of Sport Fisheries and Wildlife, and the National Park Service, in cooperation with the Corps of Engineers, Department of Health, Education and Welfare, Soil Conservation Service, and the States of Indiana and Illinois.

Appendix J: Mineral Resources is a report from the Bureau of Mines which contains an inventory of the nature and extent of mineral resources and industry in the basin, both current and projected into the future. It comments on the effects of potential reservoir sites on the mineral resources of the basin and examines the geology at each site.

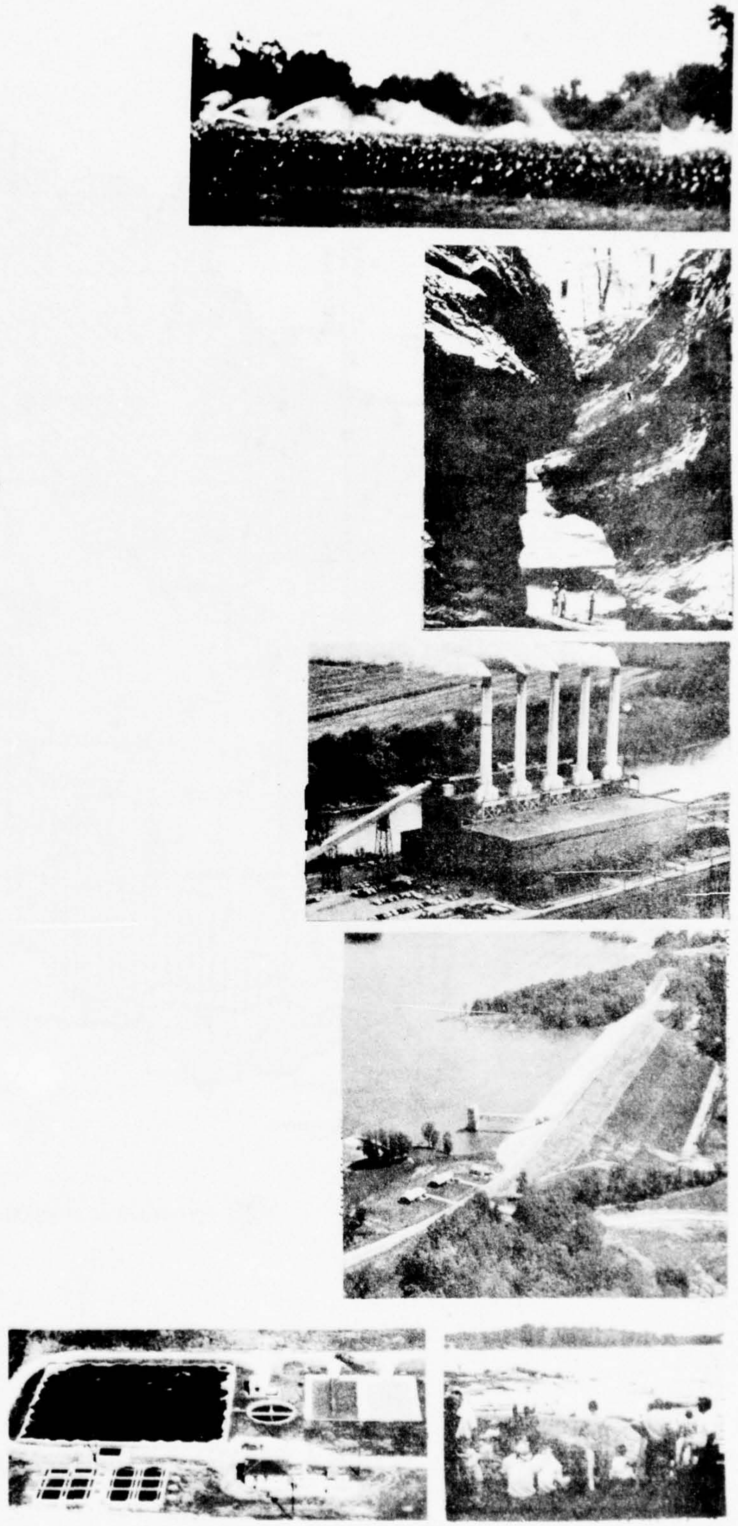
Appendix K: Power, prepared under the leadership of the Federal Power Commission, furnishes data on existing electric power facilities, projections of future electric power requirements, potentials for further hydroelectric power development and future water requirements for thermal electric power generation.

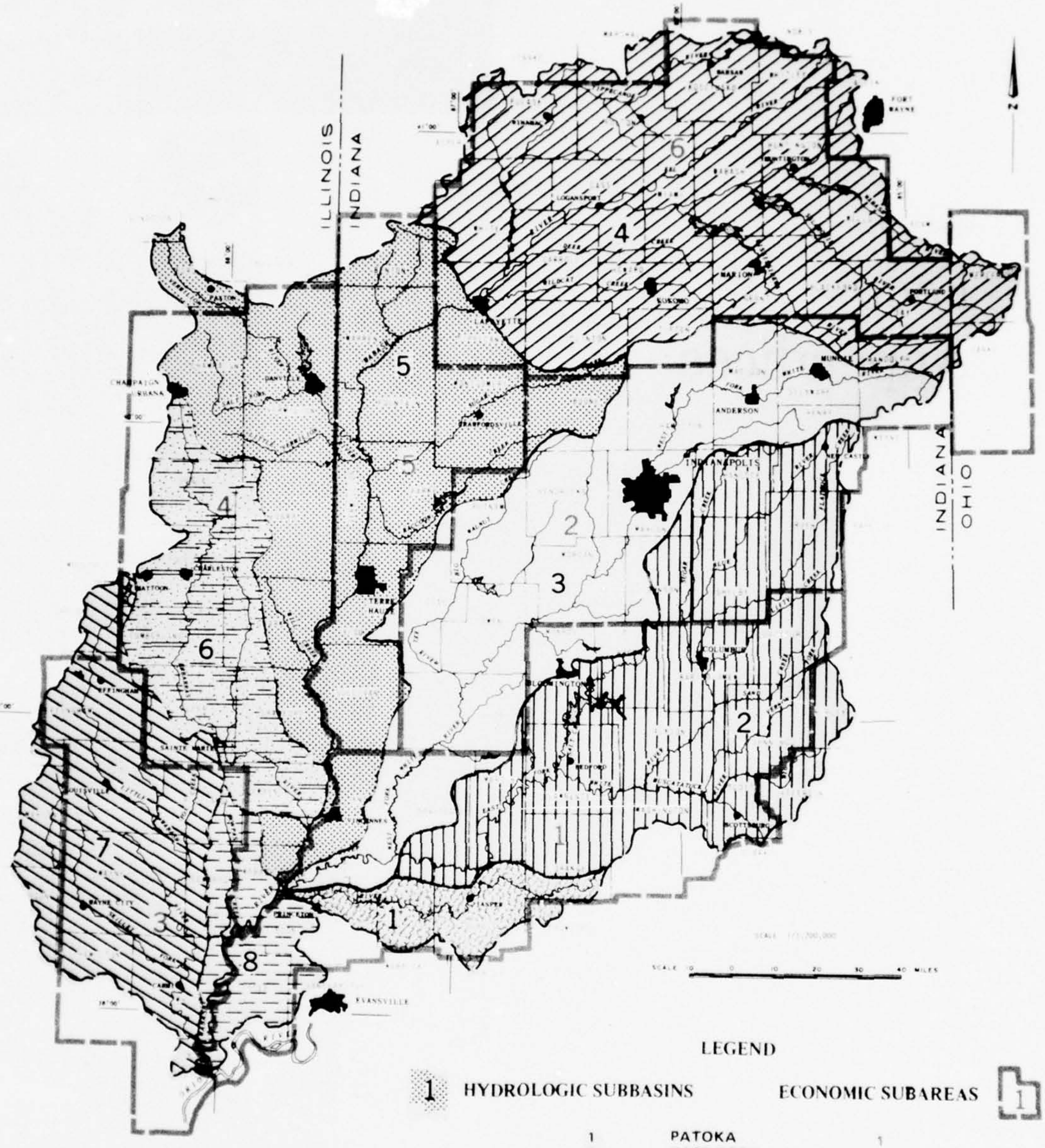
Appendix L: Project Engineering Studies, prepared with the leadership of the Corps of Engineers, describes the engineering studies for the major reservoirs. Information presented includes general criteria, project descriptions and site formulation and allocation studies.

Appendix M. State Reports, contains information on state laws, policies and programs which the cooperating states considered pertinent to their water and related land resource programs. This included data on existing developments, legislation, policies, programs and administrative structure for program implementation. Inputs to this appendix were by the States of Indiana, Illinois and Ohio. The Corps of Engineers assembled the document.

FIGURE 7.

Focus Appendices





LEGEND

1 HYDROLOGIC SUBBASINS		ECONOMIC SUBAREAS 1
1	PATOKA	1
2	EAST FORK	2
3	WEST FORK	3
4	UPPER WABASH	4
5	MIDDLE WABASH	5
6	EMBARRAS	6
7	LITTLE WABASH	
8	LOWER WABASH	

HYDROLOGIC SUBBASINS AND ECONOMIC SUBAREAS

FIGURE 8

SECTION II – PHYSICAL CHARACTERISTICS OF THE BASIN

The Wabash is born of lake and spring and nourished by rainfall, this stream that the French hunters and explorers called "Ouabache"– their White River. White it does appear, even in our day, at some points along the valley. It runs from the till plains on the Ohio-Indiana state line, rolls along the main channel between Indiana and Illinois, falling some 580 feet from its source to the mouth, a crow's glide of 270 miles, 475 by stream, winks and flashes of quiet waters with few riffles or rapids.

This is the river of the Wabash Basin which is situated within the Great Interior Plain. It is a contributing basin to the Mississippi River and has a drainage area of some 33,100 square miles within the states of Illinois, Indiana, and Ohio. The river is the largest drainage system, excluding the Tennessee River, within the Ohio River basin – comprising about 16 percent of the parent system. The basin is roughly oval in shape having a length of 285 miles and a maximum width of 190 miles. From near the town of Celina in Mercer County, Ohio, about 15 miles east of the Indiana-Ohio state line, the river begins; it flows northwest only 67 miles to Huntington, Indiana, and then on a westerly and southerly direction for 408 miles to join the Ohio River at a point 133 miles upstream from the confluence of the Ohio and Mississippi Rivers. Of the total land and water area in the basin, 8,563 square miles are in eastern Illinois, 24,218 are in central Indiana and the remaining 319 are on the west-central edge of Ohio. These areas represent 15, 67 and a nominal percentage of the above respective states.

The study area, figure 8, is bound on the north by the Great Lakes basin, while the tributary drainage areas of the Great Miami, the Ohio and the Upper Mississippi Rivers form the extreme boundaries on the east, south and west, respectively. For the purposes of analyses from the engineering and economic viewpoints, the basin was divided into six economic subareas and eight hydrologic subbasins, shown in figure 8. This facilitated basic data preparation and reporting. Data pertinent to the basin planning areas are given in table 1.

TABLE 1

BASIN PLANNING AREAS

HYDROLOGIC SUBBASINS

Number	Name	Area (Sq Mi)	Percent of Basin
1	Patoka	862	2.6
2	East Fork	5,746	17.3
3	West Fork	5,603	16.9
4	Upper Wabash	7,267	22.0
5	Middle Wabash	6,555	19.8
6	Embarras	2,438	7.4
7	Little Wabash	3,209	9.7
8	Lower Wabash	1,420	4.3

ECONOMIC SUBAREAS

Number	Number of Counties	Area (Sq Mi)	Percent of Study Area
1	17	6,945	20.1
2	17	6,990	20.2
3	8	3,514	10.2
4	11	5,839	16.9
5	8	3,267	9.4
6	20	8,017	23.2

Several of the Wabash River headwater tributary streams, the Tippecanoe, Eel, Upper Little Wabash, Salamonie, and Mississinewa Rivers, have their origin in the till plains of the Upper Wabash area. Other headwater streams originate to the east and west of the Great Valley of the Wabash, where long wooded ridges alternate with scattered woodland and past cultivated bottom lands. The western half of the basin is considerably less rolling than the eastern portion, and substantial areas of flat or gently rolling land occur in the bottoms and uplands of the Little Wabash, Embarras and Vermilion Rivers. In the eastern portion, the East and West Forks of the White River originate in flat upland plain areas; the lower valleys are deeply entrenched and the surrounding land is steeply rolling. The Patoka River originates just south of the lower East Fork of the White River in steeply rolling countryside which predominates the subbasin to within five miles of its junction with the mainstem.

The Wabash culture and economy is highly oriented to agriculture and quite logically so. The region is endowed with rich soils, abundant water

and a favorable climate, and agricultural pursuits have been the dominant influence of the region since its settlement. Later, the railroads and the area's natural resources, especially limestone, coal and petroleum have been important in molding a more diverse economy. In recent decades, the region has developed into a manufacturing center of national importance; industry is primarily engaged in the production of machinery, chemicals, fabricated metal products, automotive equipment and electrical supplies.

GEOLOGY AND PHYSIOGRAPHY

Regional Glaciation

The basin was subjected to three stages of glaciation during the Pleistocene Epoch which began about one million years ago. It is this epoch that is sometimes called the Age of Man because anthropologists now believe the earliest man evolved during this period. Four major ice advances occurred; these glacial stages have been named – from the oldest to the most recent – Nebraskan, Kansan, Illinoian, and Wisconsian. The latter three affected the basin, but the Illinoian and Wisconsian were of major significance. In the Illinoian stage, glaciation extended over the entire area with the exception of the hilly region in the south. The more recent Wisconsian stage of glaciation affected the northern half of the basin in Illinois and the northern three quarters in Indiana. The drift deposited from beneath the glaciers decreases from north to south and ranges in thicknesses up to 200 feet with thicknesses as great as 500 feet occurring in buried valleys. Among the many transformations to our Wabash, which occurred as the result of glaciation, the considerable modification to the preglacial drainage systems and the extensive glaciofluvial deposits of the stream valley are perhaps of the most consequence in present day water resources.

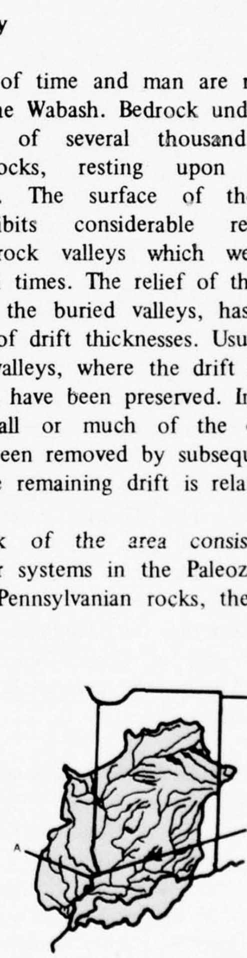
Bedrock Geology

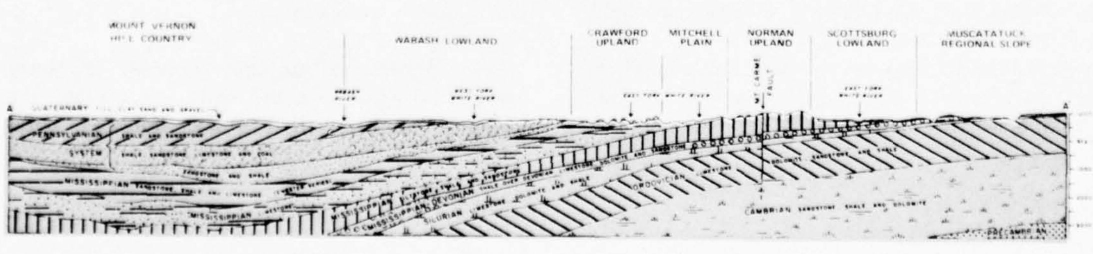
The history of time and man are recorded in the rocks of the Wabash. Bedrock underlying the basin consists of several thousand feet of sedimentary rocks, resting upon crystalline basement rock. The surface of the bedrock generally exhibits considerable relief with prominent bedrock valleys which were eroded during preglacial times. The relief of the bedrock, especially near the buried valleys, has caused a wide variation of drift thicknesses. Usually in the deeper buried valleys, where the drift is thickest, the drift sheets have been preserved. In preglacial upland areas, all or much of the older drift deposits have been removed by subsequent glacial erosion and the remaining drift is relatively thin.

The bedrock of the area consists of six classifications or systems in the Paleozoic Era of geologic time. Pennsylvanian rocks, the youngest,

FIGURE 9

GEOLOGIC CROSS-SECTION





to the older Cambrian originated from sediments deposited in shallow seas which invaded North America. When the seas receded the sedimentary deposits solidified. In the Illinois portion of the basin and southwestern Indiana, the bedrock consists of Pennsylvanian Age rocks. To the east of the Pennsylvanian beds which contain the coal-bearing formations, outcrops of Mississippian, Devonian, Silurian, and Ordovician rocks appear across Indiana. Much of east-central Indiana is underlain by rocks of Silurian age while Ordovician rocks occur in the southeastern part of the state. A geologic cross-section of the basin is presented in figure 9.

Physiography

The basin lies in and occupies portions of two physiographic provinces within the Great Interior Plain, a major physiographic division of the United States. These two provinces are the great Central Lowland and the Interior Low Plateaus. Most of the basin is situated in the Till Plains Section of the Central Lowland, an area of broad rolling prairies underlain by thick glacial deposits and with little or no relief. The southern edge of the basin is in the Shawnee Hills Section of the Interior Low Plateaus where the effects of glaciation are largely absent. It is a rugged section with bedrock exposures on steep hillsides and in narrow valleys.

The latter unglaciated section comprises an estimated 5,600 square miles of the total 33,100 square miles basin area. Stream valleys of this area were deeply eroded by the preglacial and glacial waters, and subsequently aggraded with material carried by the melt waters of the retreating glaciers. The remaining area of the basin, 27,500 square miles, has been glaciated. Generally, rough topography over-ridden by enormous ice masses was filled and levelled by the material carried or pushed ahead, resulting largely in a plain of glacial construction on which weathering has only locally been of importance since its glaciation. These glacial deposits which average about 100 feet in depth, now form some of the richest agricultural lands in the region. Within the two physiographic provinces, the basin is divided into twelve distinct physiographic areas which are described in table 2 and shown in figure 10, on the next page.

TABLE 2

DESCRIPTION OF THE PHYSIOGRAPHIC AREAS

TIPTON TILL PLAIN – Nearly flat to gently rolling glacial plain traversed by several low terminal moraines. Mainly ground-moraine deposits with some end-moraine, valley-train and outwash-plain deposits.

BLOOMINGTON RIDGED PLAIN – Low, broad, morainic ridges with intervening wide stretches of relatively flat to gently rolling ground-moraine.

SPRINGFIELD PLAIN – Flat to gently rolling upland characterized by relatively well-developed, shallow entrenchment of drainage into Illinoian drift overlying Pennsylvanian sandstones, shales, coal and limestones.

MOUNT VERNON HILL COUNTRY – Rolling topography on thin Illinoian drift over Pennsylvanian sandstones, shales, coal, and limestones. Valleys extensively aggraded with Illinoian till, glacio-lacustrine, and glacio-fluvial deposits.

KANKAKEE OUTWASH PLAIN – A nearly flat area of ground-moraine, outwash-plain, glacio-lacustrine, glacio-fluvial and sandy eolian deposits.

STEUBEN MORAINAL LAKE AREA – Uneven, morainic topography with numerous lakes of kettle origin within moraines or outwash-plains.

MUSCATATUCK REGIONAL SLOPE – Broad and flat to gently rolling, dissected upland on glacial drift over middle Paleozoic limestones and dolomites.

SCOTTSBURG LOWLAND – Nearly level to gently rolling topography on glacial drift over late Devonian and early Mississippian nonresistant shales.

NORMAN UPLAND – Dissected plateau of strong relief characterized by flat-topped narrow divides, steep slopes and V-shaped valleys developed on relatively resistant siltstones and interbedded softer shales of the Borden Group of early to middle Mississippian age.

MITCHELL PLAIN – Essentially a rolling plain developed on middle Mississippian limestones. Sinkholes, caves, and disappearing streams are common.

CRAWFORD UPLAND – Rugged, angular topography of strong relief developed on interlayered sandstones, shales, and limestones of the Chester Series of late Mississippian age and sandstones and shales of early Pennsylvanian age. Areas of karst features including caves are common.

WABASH LOWLAND – Rounded land forms of comparatively little relief developed on thin glacial drift over Pennsylvanian shales and coals. Valleys are extensively aggraded by deposition of Illinoian till, glacio-lacustrine and glacio-fluvial deposits.

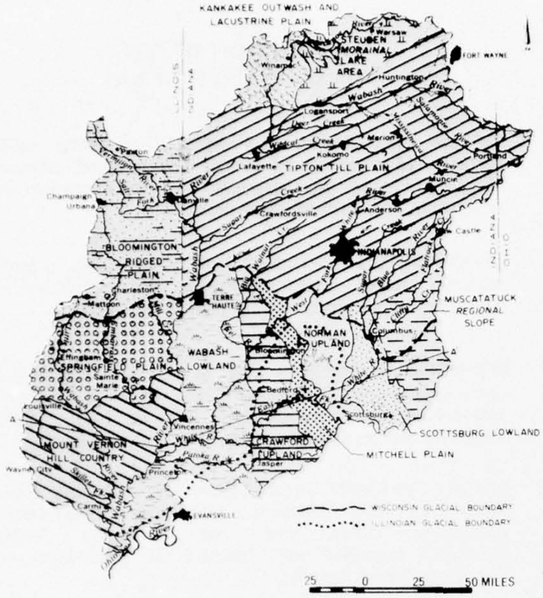


FIGURE 10

PHYSIOGRAPHIC MAP

TOPOGRAPHY

The Wabash Basin, except for the rugged, hilly section in the south, is essentially a broad prairie plain. The valleys that nestle the river and its tributaries are old, a million years old, of the Pleistocene Epoch, and while the topography molded them and since it is not spectacular in the sense of the canyonlands of the West, it is nonetheless unique.

The greatest differences in local relief within the basin are the major streams, especially along the central valleys of the main stem and East and West Fork of the White River. General basin elevations range from a maximum of about 1,300 feet above mean sea level in the area southeast of Winchester in Randolph County, Indiana, adjacent to the State of Ohio to a minimum of about 370 feet msl at the confluence of the Wabash and Ohio Rivers. Although the highest part of the basin is centered about southern Randolph County, small areas and isolated hills reach 1,000 feet msl or slightly higher in Clark, Washington, Scott, Bartholomew, Boone, Brown, Monroe, and Hendricks Counties, Indiana. Less than three percent of the Basin's total area is at elevations higher than 1,000 feet msl while about 90 percent of the area lies between elevations 500 and 1,000 feet msl; the average elevation is about 750 feet msl.

LAND RESOURCES

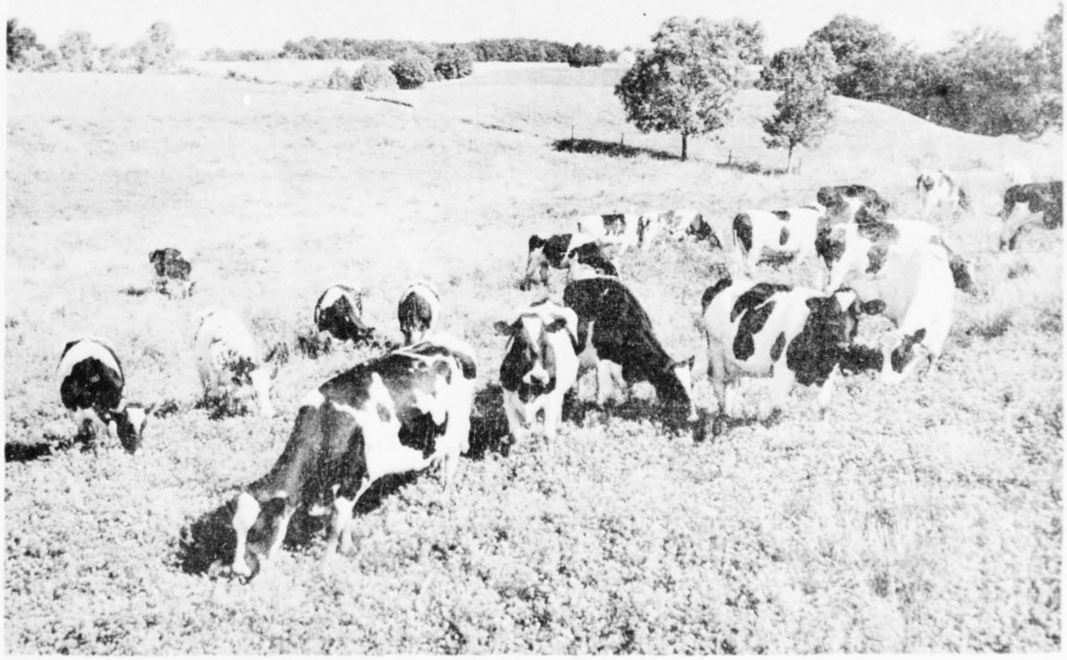
The significant range in climatic and soil conditions within the basin has resulted in distinctive patterns of agricultural and land use. Physiographically homogenous areas with essentially similar use and treatment needs, called land resource regions with small divisions called resource areas, have been delineated as shown on figure 12, which follows. There are 156 major land resource areas and 20 land resource regions in the continental United States; portions of nine resource areas and three resource regions occur within the Wabash River basin. The approximate size and characteristics of each of the Wabash areas is shown in table 3, page 21 .

Within the land resource classification, the soil resource base is also classified into eight land capability classes from Class I to VIII. Class I lands have few limitations that qualify its use; the latter class has certain hazards that prevent use for crops, pasture or trees. The Wabash Basin is predominately cropped; the land is well-adapted to agricultural production, as slightly more than two-thirds of the area is in land classes I and II. An additional twenty percent of the lands is in classes III and IV, and they are suited for cultivation following careful soil management practices.

Cropland comprises 14,091,830 acres or 64 percent of the total geographic area. Major cropland uses in order of their acreages are corn, soybeans, wheat, hay, oats, vegetables, rye, barley, fruit orchards and potatoes. About 35 percent of the cash farm income comes from the sale of corn.

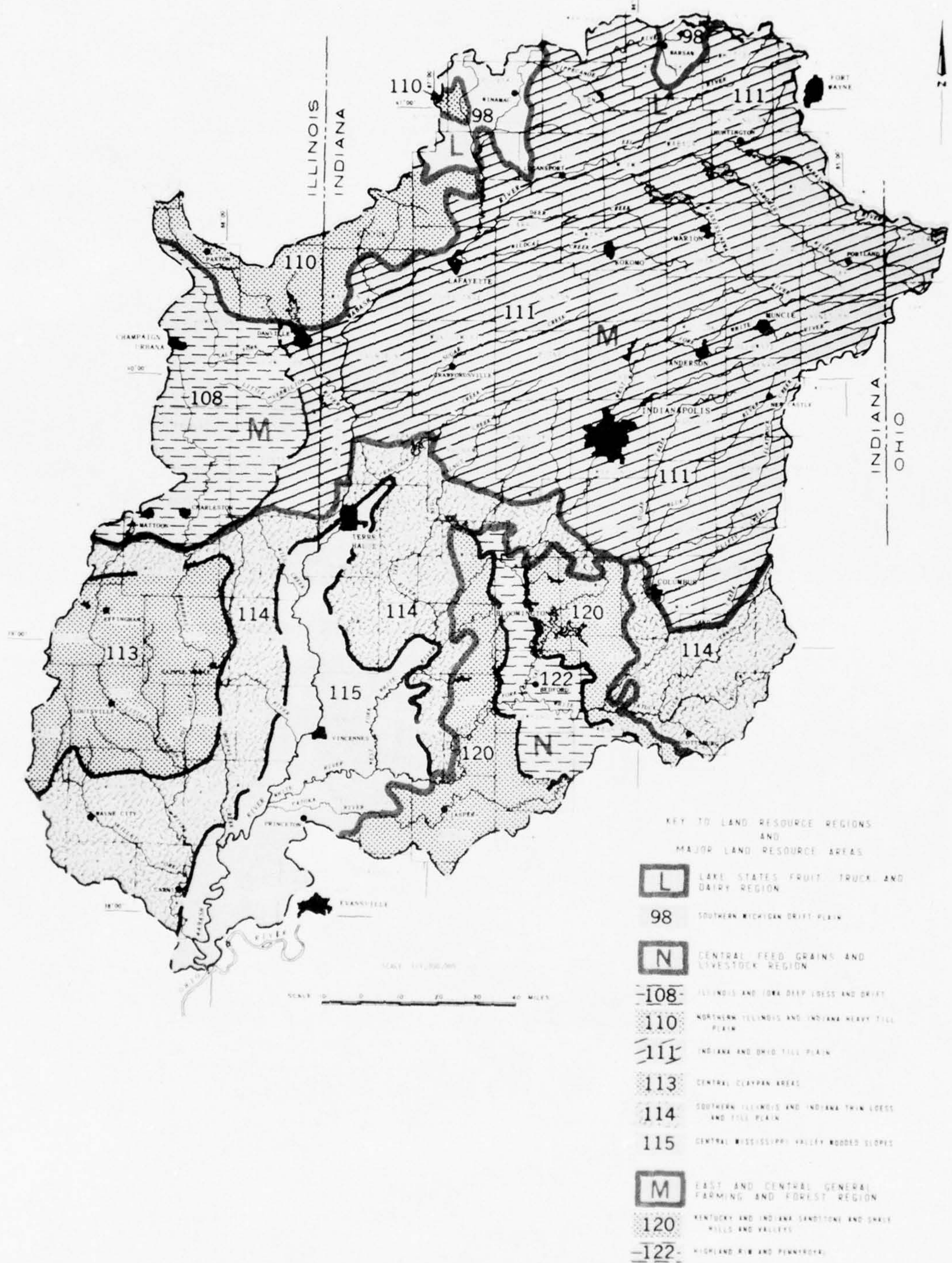
The basin falls in the Central Forest Region of Eastern North America, about 15 percent of the area is forested. Economic Subarea 1 has the largest percentage of forest area, about 30 percent. Approximately 160,000 acres or about five percent of the commercial forest land is Federally owned. Of this, 93,000 acres are in the Hoosier and the Shawnee National Forests; the other 67,000 acres

CROPLAND COMPRISES 64 PERCENT OF THE LAND AREA IN THE WABASH BASIN



LIVESTOCK PRODUCTION AND DAIRYING ARE SIGNIFICANT IN THE NORTHEASTERN PORTION OF THE BASIN

FIGURE 11



LAND RESOURCE REGIONS
AND
MAJOR LAND RESOURCE AREAS

FIGURE 12

TABLE 3
CHARACTERISTICS OF LAND RESOURCE AREAS
WABASH RIVER BASIN

Land Resource Area1/	Area 1,000 Acres	Topography	Soils
L – Lake States Fruit, Truck, and Dairy Region			
98 Southern Michigan Drift Plain	361.9 (1.6%)	Nearly level to gently sloping glaciated plains. Many depressions occur throughout the level areas, often forming closed basins.	Glaciated, light colored, clayey and sandy soils. They are mostly acid and well to very poorly drained. Some peat and muck soils are present.
M – Central Feed Grains and Livestock Region			
108 Illinois & Iowa, deep loess and drift	1,707.4 (7.8%)	Rolling to hilly topography with broad, level to undulating uplands. Local relief ranges from a few feet to 100 or 200 feet. Majority of the area has poor drainage, remainder is adequate.	Prairie soils from loess deposits dominate the area. Flats and depressions also have dark, poorly drained soils. Steep slopes have light colored soils with clay accumulation in subsoil.
110 Northern Illinois & Indiana Till Plain	1,048.1 (4.7%)	Nearly level to sloping glaciated plain. Streams have cut only shallow valleys over much of the area. Moderately good natural surface drainage Poor drainage in spots.	Prairie soils on calcareous glacial material are dominant. Dark, poorly drained soil on flats and depressions. Small tracts of light colored soils with clay accumulation in subsoil in the north.
111 Indiana & Ohio Till Plain	9,170.0 (41.7%)	A gently sloping glaciated plain interrupted in places by ridges and knolls. Surface drainage good near streams, poor away from streams. Narrow, shallow valleys.	Light colored soils on glaciated material with clay accumulation in subsoil are dominant. Southern part also has wind-blown silts. Flats and depressions have dark, poorly drained soils.
113 Central Claypan Areas	2,135.5 (9.7%)	Large portion of the area is gently sloping. Flat areas and depressions occur throughout the area.	Fertile, light and dark colored, well to poorly drained acid soils. The subsoils are mainly clayey.
114 Southern Illinois & Indiana Thin Loess & Till Plain	2,303.2 (10.5%)	Glaciated plain divided by ridges with steep slopes. Most of the ridge tops are narrow, some are broad. Surface drainage is generally good, but it is poor on flat ridge tops.	Light colored soils developed in thin loess and leached glacial till. Clay accumulation in subsoil. Some fragipans. Alluvial soils in flood plains. Strong acidity in southern part.
115 Central Mississippi Valley Wooded Slopes	2,898.6 (13.2%)	Glaciated plain crossed by steep ridges. Small streams have narrow valleys and steep gradients. Major rivers have broad, fairly level flood plains. Most drainage is good, slow runoff from areas along streams.	Light colored soils over glaciated material and bedrock. Ridge tops in southern part have fragipans. Flood plain soils consist of alluvium and dark, poorly drained soils. Generally strong acidity.
N – East and Central General Farming and Forest Region			
120 Kentucky & Indiana Sandstone & Shale Hills & Valleys	1,717.4 (7.8%)	Gently rolling to hilly sandstone and shale plateau with a loess cap. Surface drainage is good except in flat areas of plateaus and alluvial bottoms.	Light colored soils with a thin to moderately thick loess mantle over residum from acid sandstones and shales are dominant on the smooth flats and low hills. Some alluvial flood plains. Generally strong acidity.
122 Highland Rim & Pennyroyal	667.4 (3.0%)	Plateau divided by ridges especially in the west. Steep slopes and narrow valleys. Most of the surface drainage is good except it is poor in flat areas.	Light colored soils with clayey subsoil are dominant throughout the area. These soils are developed mainly in this loess and residuum from limestone. Some alluvial flood plain soils. Medium to strong acidity.
TOTAL AREA1/		22,009.5 (100.00%)	

1/ Acres based on Economic Subareas.

are under the administration of the various military agencies. State Forest ownership amounts to 89,000 acres, and the remaining 3,045,000 acres of commercial forests are in private ownership. This forest region contains cover type groups of oak-hickory, oak-pine and beech-maple on the uplands and elm--ash--cottonwood, oak-gum-cypress and mixed hardwoods in the flood plains.

CLIMATE

Climate of the Wabash River basin is of interest in the present study with particular regard to its effect on floods, droughts and the general availability of water. The climate is classed as humid continental. Climatological characteristics are influenced by generally eastward moving masses of cold polar air from the north and warm gulf air from the south. Moderate cloudiness and windiness result from the frequent eastward passage of cyclonic storms across the basin. Other characteristics include high humidity and frequent variations in temperature combined with considerable local rainfall. Atmospheric conditions are such that the occurrance of a tornado is possible several times annually.

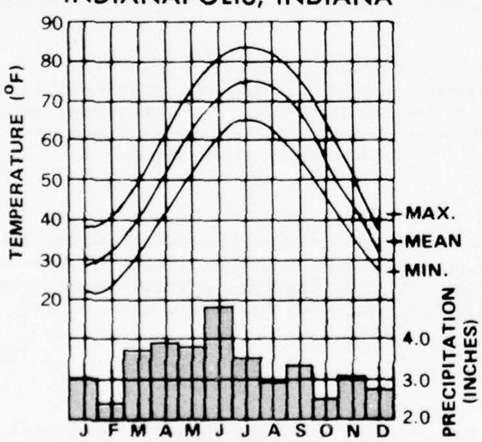


FIGURE 13

AVERAGE FOR PERIOD OF RECORD

Summers are moderately warm and humid, providing for at least one harvest. From the northern to the southern portion, the growing season varies from 145 days in the north to 200 days in the south. July, the warmest month, has an average temperature varying from 74 degrees to 78 degrees Fahrenheit (F), from Huntington, Indiana on the north to just outside the basin at Evansville on the south. Several days with temperatures over 90 degrees F can be expected each year, and extreme days to 114 degrees F have been recorded. Winters range from moderately cold in the south to more severe in the extreme north. January is the coldest month, with temperature averages ranging from 25 to 33 degrees F. Several days of subzero temperatures can be expected each winter. When extremely cold periods are being experienced in the northern portion of the basin, it is often 10 to 20 degrees warmer in the southern portion.

Precipitation including snowfall averages 40 inches annually. Although precipitation is usually greatest during June and least in February, the average seasonal variation is small. Nevertheless, there may be considerable variation from one month to another within a year and for the same month from year to year. Geographically, the northern basin receives an average of about 36 inches of precipitation annually while the southern portion receives an average of about 44 inches. Annual snowfall varies from a depth of 28 inches in the northern part to 12 inches in the south. The maximum monthly snowfall occurs in January and averages about five inches. Snow rarely remains on the ground for more than a few days at a time, and in general, it is only a small contributing factor to floods.

HYDROLOGY

The hydrology studies for this Summary Report have involved that part of the engineering work which is concerned with the origin, distribution, and properties of the waters in the Wabash Basin. These studies have required the determination of streamflows, potential reservoir characteristics, water requirements for project purposes, stream sediment loads, flood flows and ground water conditions. The general characteristics of the basin are described in the following paragraphs.

Data from selected stream gaging stations reveal that rainfall runoff tends to be fairly uniform over the basin, following the same general pattern as the rainfall itself, but there are some exceptional areas. These areas, where variations between the

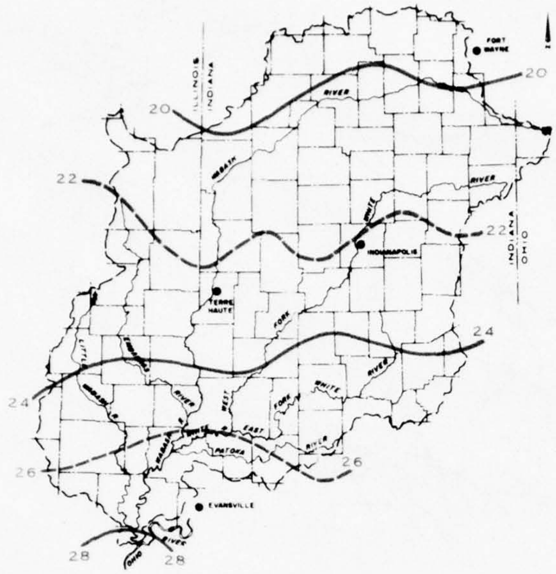


FIGURE 14

MEAN DAILY MINIMUM TEMPERATURE (°F), JANUARY

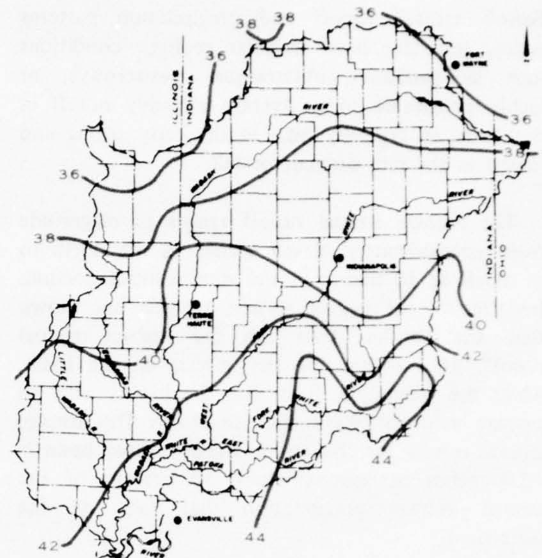


FIGURE 15

NORMAL ANNUAL PRECIPITATION (INCHES)

FIGURE 16

MEAN DAILY MAXIMUM TEMPERATURE (°F), JULY

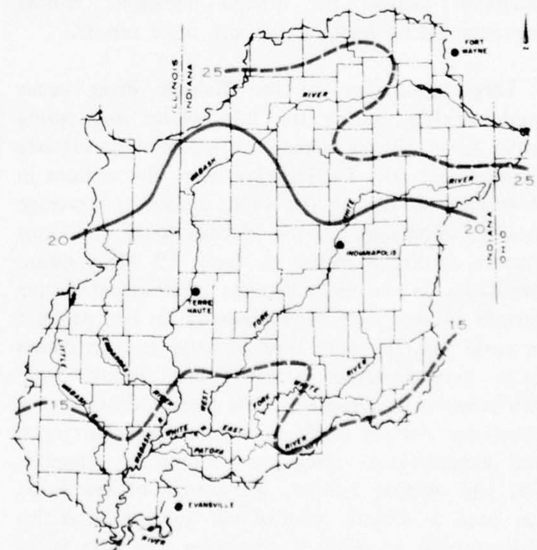


FIGURE 17

MEAN ANNUAL SNOWFALL (INCHES)

Basin's rainfall runoff and precipitation patterns occur, generally have irregular geologic conditions such as sinkholes, subterranean waterways, or highly permeable soils. Average monthly runoff in the basin is typically high in the early spring and lowest in the late summer or fall.

The average annual runoff ranges in magnitude from approximately eleven inches in the north to as much as 18 inches in the south-central portion. Investigation of gaging station records has shown that the Patoka River has the highest annual runoff, 16.2 inches, of any stream in the basin, while the Vermilion River has the lowest with an average value of 9.3 inches per year. The average annual runoff for the entire Wabash River basin is 12.0 inches or approximately 30 percent of the annual average precipitation that falls on the watershed.

The frequency and magnitude of flood producing storms in the Wabash varies from area to area, but individual storms seldom cover the entire basin. During the winter season, flooding in headwater areas is generally associated with rainfall on impermeable frozen ground and increased runoff due to the rain combined with rapid snow melt. Throughout the basin the occurrence of flood flows during any season of the year is possible and are generally caused by intense localized storms accompanied by high rainfall and rapid runoff.

Large discharges on the Wabash River occur predominately during the late winter and spring while flows of low volume are recorded during late summer and fall. To illustrate these fluctuations in flow patterns during the year, a chart of average monthly discharges on the Wabash River at Mount Carmel, Illinois is shown in figure 19. Many minor tributaries in the basin become intermittent during periods of dry weather. Frequently, in late summer or early fall, the only flow in some streams comes from ground water seepage since runoff from precipitation is negligible. Low stream flows during these dry periods result in water supply shortages, and unsatisfactory stream conditions for adequate fish and wildlife habitat. Knowledge of low flows has been a specific interest for this report as this characteristic is required to design adequate water facilities, water treatment plants, agricultural and industrial operations and low flow releases for water quality control and recreational purposes.

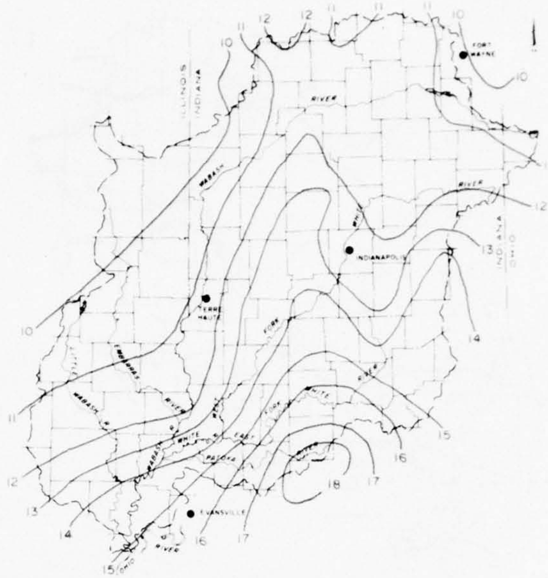


FIGURE 18

AVERAGE ANNUAL RUNOFF (INCHES)

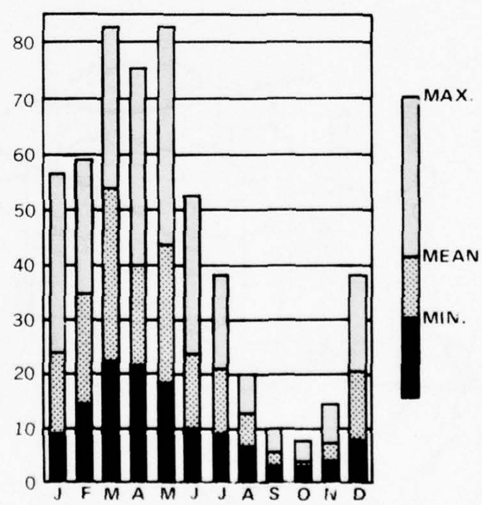


FIGURE 19

AVERAGE MONTHLY DISCHARGE
MT. CARMEL, ILLINOIS
(THOUSAND C.F.S.)

SOCIO-ECONOMIC ELEMENTS

In 1965 the Wabash River basin contained 3,250,000 people; approximately 56 percent of the population can be classified as urban dwellers, while 44 percent live in rural areas. The major portion of the population is concentrated in the northern half with the greatest density being in the metropolitan area of Indianapolis, Indiana. Population densities by county for the entire watershed are presented in figure 20. Other large population centers in the basin are Terre Haute, Muncie, Anderson, Kokomo, and Lafayette, Indiana, and Danville and Urbana, Illinois. Increased urbanization combined with existing modes of transportation and the distribution of natural resources has resulted in contrasting variations in economic conditions throughout the area.

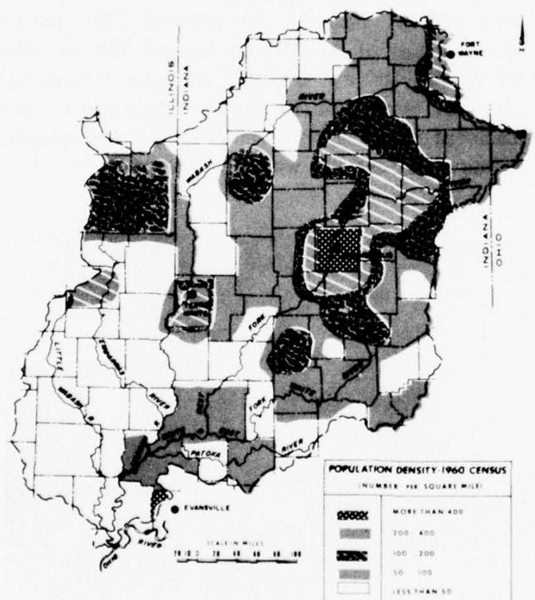


FIGURE 20

POPULATION DENSITY

In terms of its most widely known economic characteristics, the Wabash River basin is very often referred to as simply being part of the nation's corn belt. It generally lies in that portion of the mid-West known as the nation's "bread basket". However, in recent decades the study area has also become widely known as one of the nation's expanding manufacturing centers. Today, in addition to its broad agricultural base engaged in the production of livestock and grain, the study area has amassed several large and growing manufacturing complexes engaged primarily in the production of machinery, chemicals, fabricated metal products, automotive, and electrical equipment and supplies. The major manufacturing centers are located in and around the aforementioned population centers.

During the 1940's and 1950's westward expansion of the nation's manufacturing belt into the northern and central portions of Indiana and Illinois brought an increasing number of new and fast-growing industries into the study area and with them much greater employment opportunities for thousands of people. It also brought heavy rural migrations into industrial centers of the Wabash River basin. The mounting concentrations of people in some urban areas have created manifold increases in demands for housing, trade, health, education and other consumer oriented services and facilities.

ENVIRONMENTAL FEATURES

Today we are engaged in an effort to preserve for future generations a meaningful remnant of the scientific, historical, archeological, and scenic heritage of our nation. The early settlers, in their efforts to wrest a living from the land, met the wilderness as a foe to be conquered. The pattern of destruction unfortunately continued beyond the pioneer era, and it is still with us today. The basin has long been an area of educational and scientific interest, because of the diversified varieties of flora and fauna that exist in various locations within its boundaries. Many elements of environmental resource heritage can be found that may warrent preservation for future generations.

The forests of the southern valley were once among the finest in the United States, but today, only a few stands of virgin timber remain as reminders of those great forests. The karst features found in the south central part of the watershed offer many examples of geologic interest; over 400 caves have been identified in the area. Many of these natural areas can and do serve as working laboratories for the pursuit of the natural sciences by educators, students and the general public.

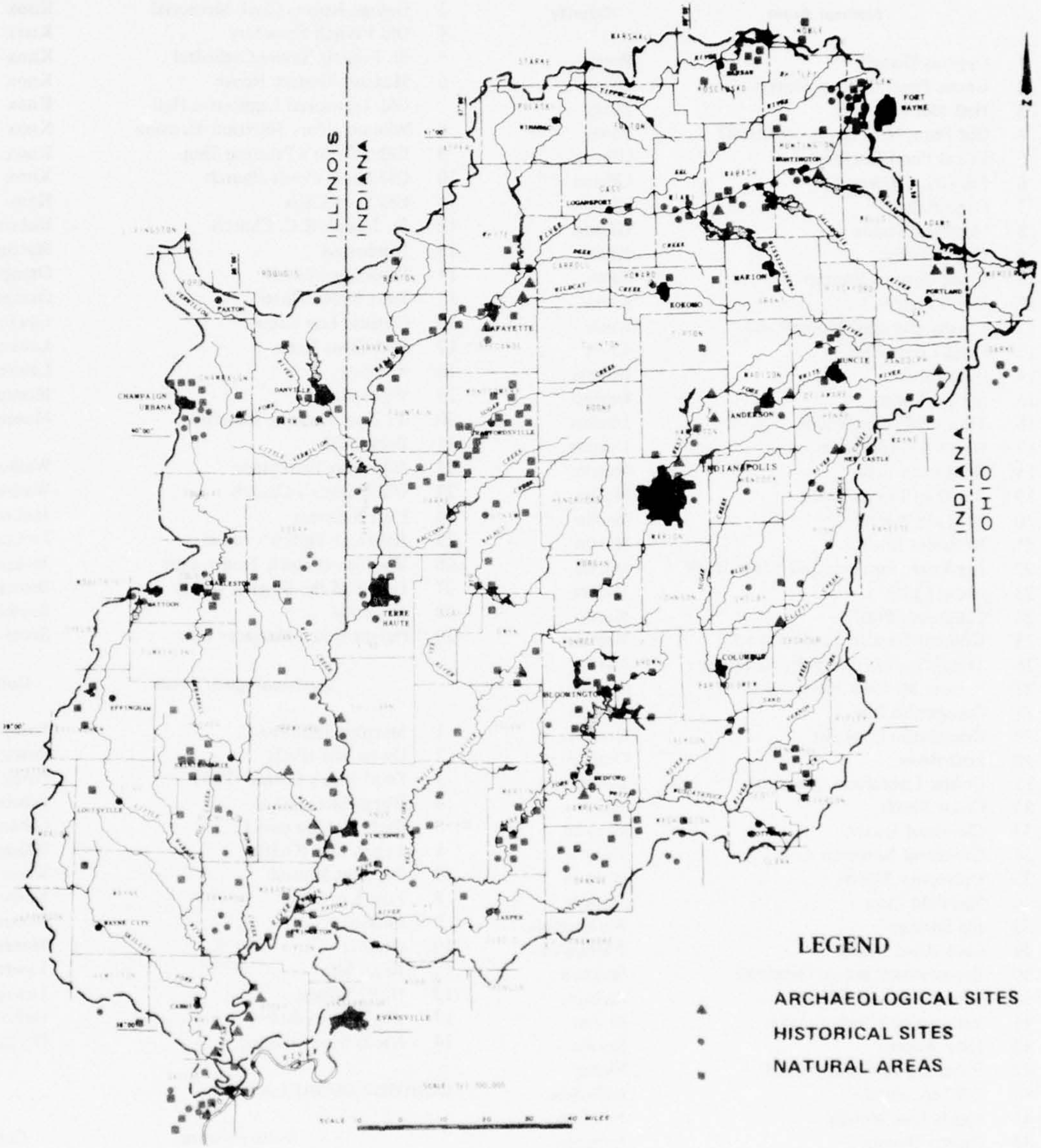
Evidences of past Indian life are numerous throughout the region. Over 2,000 archeological sites, primarily open camps, villages and settlements, have been identified and recorded. Sites of a more specialized nature such as shell middens, earth and stone burial mounds, cemeteries, geometric earthworks, and flat-top earth mounds have also been found. Eleven different ethnic groups are known to have been present in the Wabash Valley either as residents or treaty claimants. With such a background, it can be concluded that the Wabash Basin offers unusual opportunities for study of North American pre-history.

Like the period of pre-history, the pioneer movement in the basin has many interesting facets worthy of preservation. A rich heritage of great historical importance is associated with this area; events occurred in the Wabash Valley that had significant influence on shaping the modern society of the mid-west and the country. The preservation of historically valuable sites and the interpretation of their history is an important part of the conservation of the Basin's environmental resources. Figure 22 illustrates the historical and archeological sites and the natural areas of significance that are located in the basin; table 4 summarizes the sites by Economic Subarea.

The present day scenery of the basin includes a wide range in topography, vegatation, and geologic conditions. The northern portion is typified by gently rolling uplands with a predominance of cultivated acreage broken by scattered wooded areas and traversed by the river and its tributaries. In contrast, the southern part of the basin contains an abundance of forested slopes and hills that are noted especially for their beautiful autumn foliage. Of particular note is the wide variety of scenery found in this section. From west to east, one encounters the wooded slopes of the Mount Vernon Hill Country and the Wabash Lowlands, the rugged wooded hills of the Crawford Upland and the Mitchell Plain with its characteristic caverns, subterranean drainage and associated karst features, such as sinking streams, sink holes, and cave springs. East of the Mitchell Plain lie the wooded hills of the Norman Upland, the low relief of the Scottsburg Lowland and the Muscatatuck Regional Slope with its deeply entrenched streams. Each of these areas offers unique and pleasing scenery that changes with the seasons.

(Courtesy of Outdoor Indiana Magazine)

FIGURE 21. ONE HUNDRED AND ELEVEN COVERED BRIDGES ARE LOCATED IN THE WABASH BASIN



ENVIRONMENTAL INVENTORY

FIGURE 22

TABLE 4

IDENTIFIED ENVIRONMENTAL RESOURCES

ECONOMIC SUBAREA 1

	Natural Areas	County
1	Cypress Slough	Posey
2	Goose Pond Cypress Slough	Posey
3	Half Moon Woods	Posey
4	Old Dam, New Harmony Cutoff	Posey
5	Broad Pond Complex	Gibson
6	Pin Oak Flatwoods	Gibson
7	Cane Ridge	Gibson
8	Hemmer Woods	Gibson
9	Claypole Hill	Knox
10	Little Cypress Swamp	Knox
11	Don's Pond	Knox
12	Brushy and Half Moon Pond	Knox
13	Pond Creek Hills	Knox
14	High Rock	Dubois
15	Sandy Woods	Daviess
16	Thousand Acre Woods	Daviess
17	White Squirrel Area	Daviess
18	Hindostan Falls	Martin
19	Bluffs of Beaver Road	Martin
20	Dr. Lett Woods	Martin
21	McBrides Bluff	Martin
22	Jug Rock, Pinnacle and House Rock	Martin
23	Cedar Cliffs	Martin
24	Callahan's Bluff	Martin
25	Williams Dam to Lindley Rock	Martin
26	Trinty Springs and Sulphur Spring	Martin
27	Pioneer Mothers Memorial	Orange
28	Orangeville Rise	Orange
29	Orangeville Lookout	Orange
30	Lost River	Orange
31	Oolitic Limestone Quarries	Lawrence
32	Cedar Bluffs	Monroe
33	Cleveland Quarry	Monroe
34	Grossland Research Area	Monroe
35	University Woods	Monroe
36	Mayfield Cave	Monroe
37	Big Springs	Washington
38	Cave River Valley	Washington
39	Brownstown Scenic Overlook	Jackson
40	Cardinal Flower Marsh	Jackson
41	Yellowwood Nature Area	Brown
42	Lilly Woods	Brown
43	Reinking Memorial Forest	Ripley
44	Officers Woods	Jefferson
45	Biehle Oak Woods	Jennings
46	Palmer Woods	Jennings
47	Guthrie Woods	Jennings
48	Jennings County Fairground Woods	Jennings
49	Muscatatuck River Area	Jennings
50	Walker Woods	Jennings
51	Conboy Woods	Jennings

	Historical Areas	County
1	New Harmony Natural History District	Posey
2	Delectable Hill	Pike
3	George Rogers Clark Memorial	Knox
4	Old French Cemetery	Knox
5	St. Francis Xavier Cathedral	Knox
6	Madame Godare House	Knox
7	Old Territorial Legislative Hall	Knox
8	William Henry Harrison Mansion	Knox
9	Elihu Stout's Printing Shop	Knox
10	Old Maria Creek Church	Knox
11	Old Fort Knox	Knox
12	St. Joseph R.C. Church	Dubois
13	Hindostan	Martin
14	Paoli Courthouse	Orange
15	West Baden Hotel	Orange
16	Guthrie Log Cabin	Lawrence
17	Red Cross Farm	Lawrence
18	Bedford	Lawrence
19	Wylie House	Monroe
20	Virginia Furnace Remains	Monroe
21	Becks Mill	
22	John Hay Birthplace	Washington
23	Old Quaker's Church	Washington
24	Fort Vallonia	Jackson
25	Battle of Tipton's Island	Jackson
26	The Ten O'clock Treaty Line	Jackson
27	House of the Singing Winds	Brown
28	Nashville	Brown
29	*Pigeon Roost Massacre Site*	Scott

	Archaeological Areas	County
1	Murphy Site (Po1)	Posey
2	Owen Site (Po2)	Posey
3	Dead Man's Corner (Po3)	Posey
4	Weber Site (Gi13)	Gibson
5	Shell Midden (Gi11)	Gibson
6	Lynch Site (Gi30)	Gibson
7	Pyramid Mound	Knox
8	Fort Knox II	Knox
9	(Mn66)	Monroe
10	(Mn72)	Monroe
11	Bond Site	Lawrence
12	(Lr9) Village	Lawrence
13	(Du7) Rockshelter	Dubois
14	(De2) Stone Mound	Decatur

ECONOMIC SUBAREA II

	Natural Areas	County
52	Prairie	Green
53	Green Bluff	Owen
54	Hoot Woods	Owen
55	McCormick's Cove	Owen
56	Cataract Falls	Owen
57	Cataract Lake Spillway Cut	Putnam
58	Winora Welch Botanical Area	Putnam
59	Fern Cliff	Putnam
60	Vermillion Falls	Putnam

TABLE 4

IDENTIFIED ENVIRONMENTAL RESOURCES (CONTINUED)

	Natural Areas	County
61	Big Walnut Creek Valley	Putnam
62	Fallen Rock	Putnam
63	Blue Bluffs	Morgan
64	Bradford Nature Preserve	Morgan
65	Woolens Garden	Marion
66	W.S. Blatchley Sanctuary	Hamilton
67	Meltzer Woods	Shelby
68	Ball State Wildlife Preserve	Delaware
69	McColm Bog	Delaware
70	Old Prairie Swamp	Delaware
71	Ginn's Woods	Delaware
72	Blue-Wing Teal Pond	Randolph
73	Cabin Creek Raised Bog	Randolph
74	Davis Forestry Farm	Randolph

	Historical Areas	County
30	Benhamin Harrison House	Marion
31	Lockerbie Street Home	Marion
32	House of Twin Chimneys	Marion
33	Prosser House	Marion
34	Albert Fletcher Museum	Marion
35	Christ Church	Marion
36	Kempa House	Marion
37	Meredith Nicholson House	Marion
38	Fairbanks House	Marion
39	Camp Robinson	Marion
40	Booth Tarkington Home	Marion
41	Camp Morton	Marion
42	Conner Prairie Farm	Hamilton
43	Early Gaswell	Delaware
44	Rosewell-Finley House	Shelby
45	James Whitcomb Riley Home	Hancock
46	Morovian Mission	Madison
47	Glacial Esker	Madison
48	Raleigh Schoolhouse	Rush
49	Shafer Home	Henry
50	Wilbur Wright Birthplace	Henry
51	Spiceland Academy Site	Henry
52	Munsee Town Indian Village	Delaware
53	General Ashel Stone Home	Randolph

	Archaeological Areas	County
15	Osborn Mount Group	Greene
16	Hastings Village	
17	Shephard Shell Heap	
18	Ow8	Owen
19	Mississippian Village (Mg1)	Morgan
20	Oliver Farm	
21	(Sh33)	Shelby
22	New Castle Earthworks Complex	Henry
23	Strawtown Site	Hamilton
24	Mounds (M2)	Madison
25	Thornburg Site	

ECONOMIC SUBAREA III

	Natural Areas	County
75	Bottomland	Gallatin
76	Buzzards Point	Gallatin
77	Salt Wells	Gallatin
78	The Rapids	Gallatin
79	Dogtown Hills	Gallatin
80	Bottomland Swamp	Gallatin
81	L.P. Dolan Lake Conservation Area	Hamilton
82	Sam Dale Lake Conservation Area	Wayne
83	Prairie Chicken "Booming Grounds"	Wayne, Richland, Clay
84	Marks Scientific Study Area	Edwards
85	Cline Woods	Richland
86	Ridgeway Memorial Bird Preserve	Richland
87	Forests on the Upper Ravine Slopes	Clay
88	Wildcat Hollow	Effingham
89	Rattlesnake Hollow	Effingham
90	Fern Cliff	Effingham

	Historical Areas	County
54	John Crenshaw House	Gallatin
55	Carl W. Erwins House	Gallatin
56	Alexander K. Lowe House	Gallatin
57	John Marshall House	Gallatin
58	Methodist Church	Gallatin
59	Sheridan Tavern	Gallatin
60	Old Shawneetown State Memorial	Gallatin
61	First Illinois Bank	Gallatin
62	First National Bank of Shawneetown	Gallatin
63	John Robinson House	White
64	Cloud State Bank	Hamilton
65	George French House	Edwards
66	Gibson Harris House	Edwards
67	Dr. Thompson House	Edwards
68	Christian Church	Richland
69	MacBurg Methodist Church	Richland

	Archaeological Areas	County
26	Hubele Site	White
27	Oil Well Site	White

ECONOMIC SUBAREA IV

	Natural Areas	County
91	Beall's Woods	Wabash
92	Hanging Fork	Wabash
93	Berryville Coal Ball Area	Lawrence
94	Billet Marshland	Lawrence
95	Robeson Hills	Lawrence
96	Purgatory Swamp	Lawrence

TABLE 4

IDENTIFIED ENVIRONMENTAL RESOURCES (CONTINUED)

	Natural Areas	County
97	Palestine Bluff	Crawford
98	Donnelly Sanctuary	Jasper
99	Nature Conservancy Sanctuary	Jasper
100	Mixed Forest	Jasper
101	Ralph Yeatter Sanctuary	Jasper
102	Max McGraw Sanctuary	Jasper
103	Sanctuary Number 4	Jasper
104	Cleone Woods	Clark
105	Rocky Branch	Clark
106	Foley Memorial Woods	Edgar
107	Baber Woods	Edgar
108	Sargent's Woods	Cumberland
109	Hillside Marsh	Cumberland
110	Burgner Acres	Cumberland
111	Lakeside Campus Area	Coles
112	Silver Stone Farm Area	Coles
113	Pole Cat Creek Area	Coles
114	Glover Marsh	Champaign
115	Trelease Woods	Champaign
116	Brownfield Woods	Champaign
117	Stidham Woods	Champaign
118	Purnell Woods	Champaign
119	Nellie Hart Memorial Woods	Champaign
120	Jordan Creek Valley	Vermilion
121	Vermilion River Observatory	Vermilion
122	Orchid Bluff	Vermilion
123	Marshy Area	Vermilion
124	Camp Drake	Vermilion
125	A 160 Acre Site	Vermilion

	Historical Areas	County
70	Wabash River Ferry	Lawrence
71	Lincoln Trail State Memorial	Clark
72	Hutson Memorial	Crawford
73	McCann House	Clark
74	Lincoln Gravesite	Coles
75	Hiram T. Rutherford	Coles
76	Shiloh Cemetery	Coles
77	Tycer House	Coles
78	Austin House	Edgar
79	Edgar County Courthouse	Edgar
80	Pine Grove School	Edgar
81	Elmer Allison House	Champaign
82	Altgelt Hall	Champaign
83	Christian Science Student Center	Champaign
84	Alfred Houston House	Champaign
85	Illini Assembly Hall	Champaign
86	A.P. Meharr Y Farm	Champaign
87	Herbert W. Mumford House	Champaign
88	Fithian House	Vermilion
89	Hoopes House	Vermilion
90	Reason Hooten House	Vermilion
91	Vermilion County Museum	Vermilion

	Archaeological Sites	County
28	W127	Knox
29	Otter Pond (Liv125)	Lawrence
30	Allison Village (Liv249)	Lawrence
31	Purgatory Swamp (Liv25)	Lawrence
32	Gamble Site	Lawrence
33	Stoner Site (Civ109)	Crawford
34	Fox-McCarthy (Civ125)	Crawford
35	Swan Isiand (Cr319)	Crawford
36	Bumblebee Site (Cl233)	Clark
37	Chenoweth Site (Cl185)	Clark

ECONOMIC SUBAREA V

	Natural Areas	County
126	Hulman Park Woods	Vigo
127	Little Bluestem Prairie	Vigo
128	Woods of the Giants	Vermillion
129	Sword Moss Gorge	Parke
130	Allee Memorial Forest	Parke
131	Falls Canyon Nature Area	Parke
132	Rocky Hollow	Parke
133	Beckville Woods	Montgomery
134	Custer's Woods	Montgomery
135	Lye Creek Prairie Burn	Montgomery
136	Pine Hills Nature Preserve	Montgomery
137	Rush Woods	Montgomery
138	Sugar Creek	Montgomery
139	Three Glaciers Cut	Montgomery
140	Boulder Train	Montgomery
141	Cring Memorial Woods	Montgomery
142	Kickapoo Falls	Warren
143	Fall Creek Gorge	Warren
144	High Bridge Botanical Area	Warren
145	Falls at Williamsport	Warren
146	Big Pine Creek	Warren
147	Kate's Pond	Warren
148	Bear Creek Canyon, Portland Arch	Fountain
149	Pedestal Rock Nature Area	Vermillion
150	Devil's Bowl	Warren
151	Prairie	Benton

	Historical Areas	County
92	Merom, Union Christian College	Sullivan
93	Fort Azatlan	Sullivan
94	Eugene V. Debs Home	Vigo
95	Dresser (Dreiser) Home	Vigo
96	Fort William Henry Harrison	Vigo
97	Blackford-Condit House	Vigo
98	Nathaniel Preston House	Vigo
99	Ernie Pyle Birthplace	Vermilion
100	Armiesburg	Parke
101	Lusk Family Home and Mill Site	Parke

TABLE 4

IDENTIFIED ENVIRONMENTAL RESOURCES (CONTINUED)

	Archaeological Areas	County
38	Merom Site (Su3)	Sullivan
39	Penitentiary Site (V18)	Vigo
40	Earthmounds (V11 and V12)	Vigo
41	Catlin Site	Vermilion

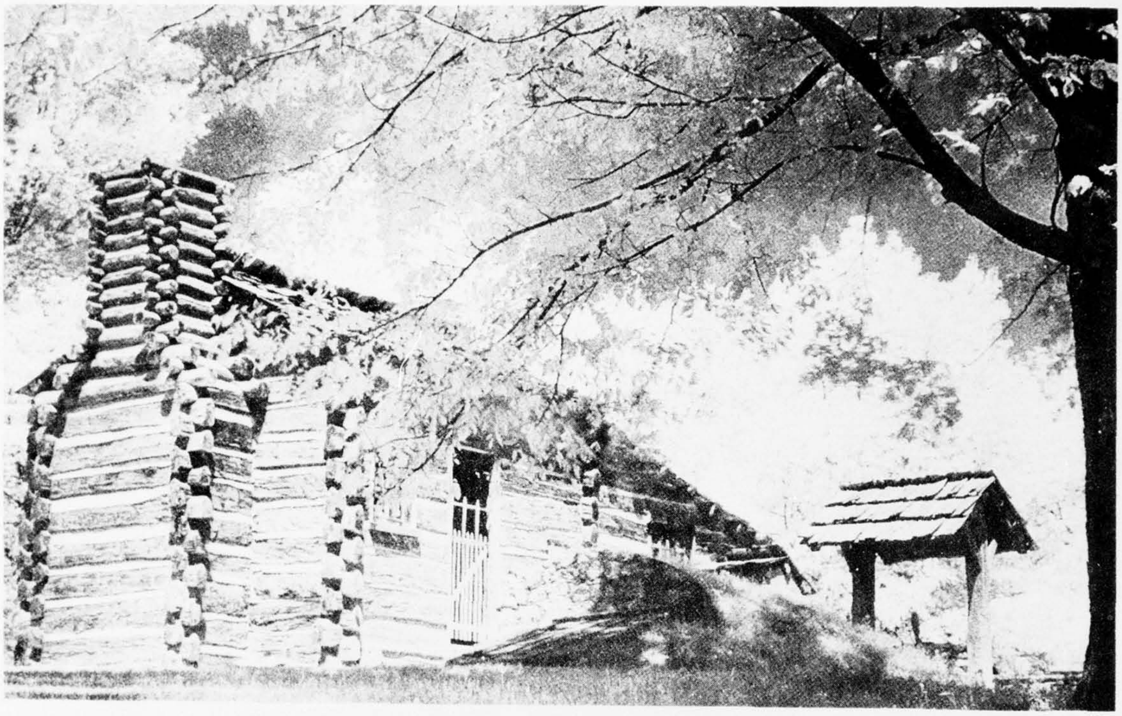
ECONOMIC SUBAREA VI

	Natural Areas	County
152	Purdue-Baker Wildlife Area	Tippecanoe
153	Ross Biological Reserve	Tippecanoe
154	Black Rock	Tippecanoe
155	Clegg Botanical Garden	Tippecanoe
156	Redwood Right of Way	White
157	Small Remnant Prairie	White
158	Indian Prairie	Tipton
159	Shenks Woods	Howard
160	Flood Plain Beech - Maple Stand	Cass
161	Pulpit Rock	Cass
162	Railroad Prairie	Howard
163	Seven Pillars of the Mississinewa	Miami
164	Botany Glen	Grant
165	Big Four Cut	Wabash
166	Hanging Rock	Wabash
167	Honeywell Woods	Wabash
168	Disko High Bogs	Wabash
169	Laketon Bog	Wabash
170	Odgen Woods	Wabash
171	Shanty Falls	Wabash
172	Rosburgh Woods	Koscuisko
173	Grider's Woods	Koscuisko
174	Wyland Lake	Koscuisko
175	Bog	Koscuisko
176	Woods	Koscuisko
177	Grassy Creek Lake	Koscuisko
178	Thornhill Nature Preserve	Huntington
179	Wygant Woods	Huntington
180	Deam Oak Monument	Wells
181	John Craig Memorial Forest	Jay
182	Drew Woods	Darke
183	Limberlost State Memorial	Adams
184	Fox Island	Allen
185	Spring Lake Woods and Bog	Allen
186	Devil's Hollow	Allen
187	Meyer's Marsh	Allen
188	Martin Woods	Allen
189	Klingler Woods	Allen
190	Greenwood Lake	Allen
191	Long Swamp Woods and Pond	Noble
192	Merry Lea Nature and Religious Center	Noble

	Historical Sites	County
102	Tippecanoe Battlefield	Tippecanoe
103	Battle of Old Town Site	Cass
104	Pumpkinville Pike	Howard
105	Cole Porter Home	Miami
106	Osage Village Site	Miami
107	Frances Slacum Gravesite	Wabash
108	Ben Wallace Circus Remains	Miami
109	Mississinewa Battlefield	Grant
110	Mt. Pleasant Trading Post	Miami
111	Gabriel Godfrey Home	Miami
112	Paradise Springs Treaty Signing	Wabash
113	Wabash-Erie Canal Remains	Wabash
114	Lambdin P. Milligan Home	Huntington
115	Forks of the Wabash	Huntington
116	Chief LaFontaine Home	Huntington
117	Little Turtles Eel River Trading Post	Whitley
118	Little Turtles Village	Whitley
119	LaBalmo Massacre Site	Whitley
120	Thomas Riley Marshall Home	Whitley
121	Bears Mill	Drake
122	Fort Greeneville Site	Drake
123	Fort Jefferson Site	Drake
124	Fort Recovery State Memorial	Mercer
125	Smith Tavern	Mercer

	Archaeological Areas	County
42	Woodland Village (T2)	Tippecanoe
43	Fort Ouiatenon (T9)	Tippecanoe
44	Wea Village (T6)	Tippecanoe
45	Bangs Site	Huntington
46	Votaw Site	Jay

FIGURE 23. PORTIONS OF THE BASIN ARE USED BY MIGRATORY WATERFOWL FOR WINTERING AREAS



MANY REMINDERS OF OUR PIONEER HERITAGE EXIST IN THE WABASH VALLEY

(Courtesy of Outdoor Indiana Magazine)

APPROXIMATELY 3,350,000 ACRES OF THE STUDY AREA ARE CLASSIFIED AS FOREST LAND

FIGURE 24.

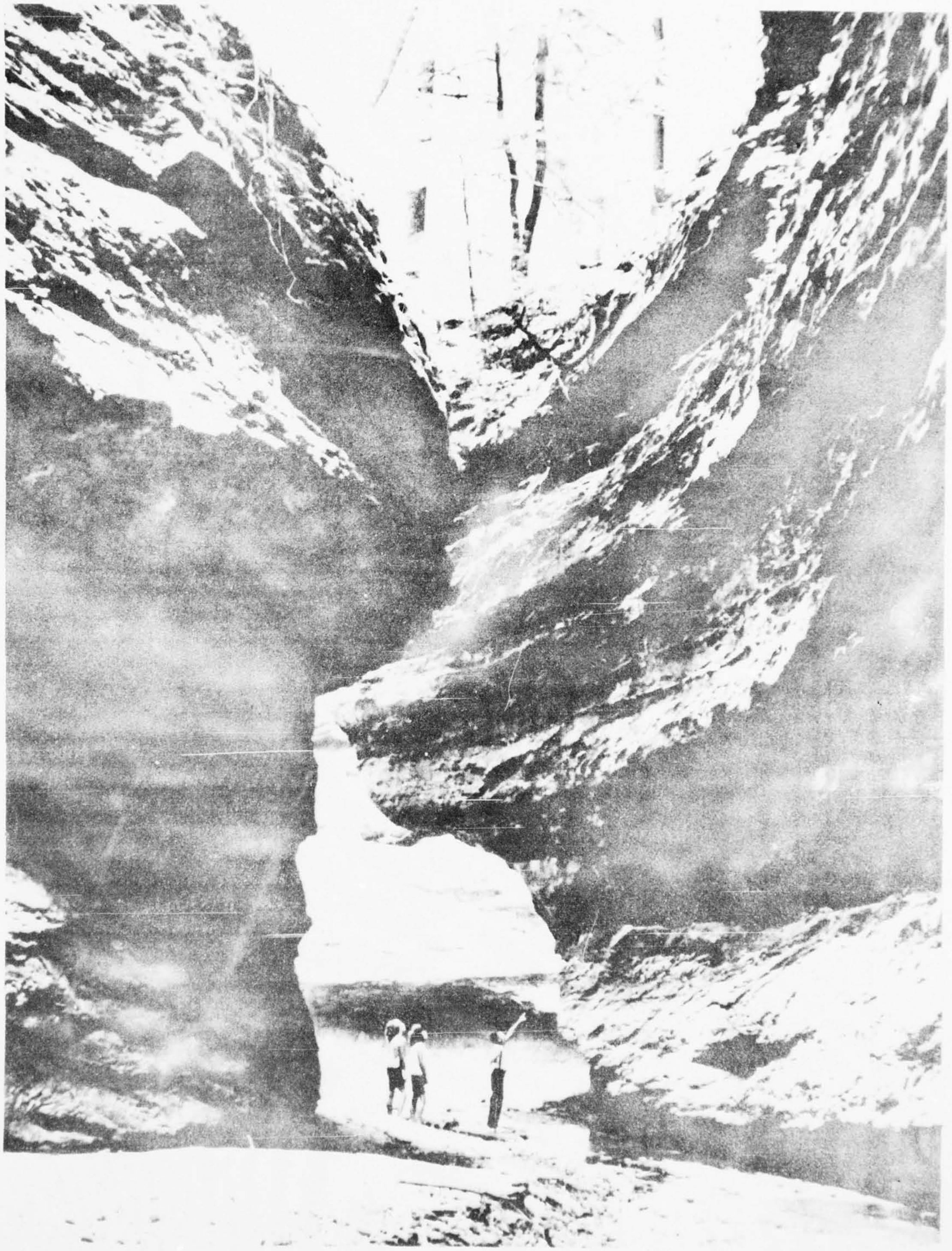
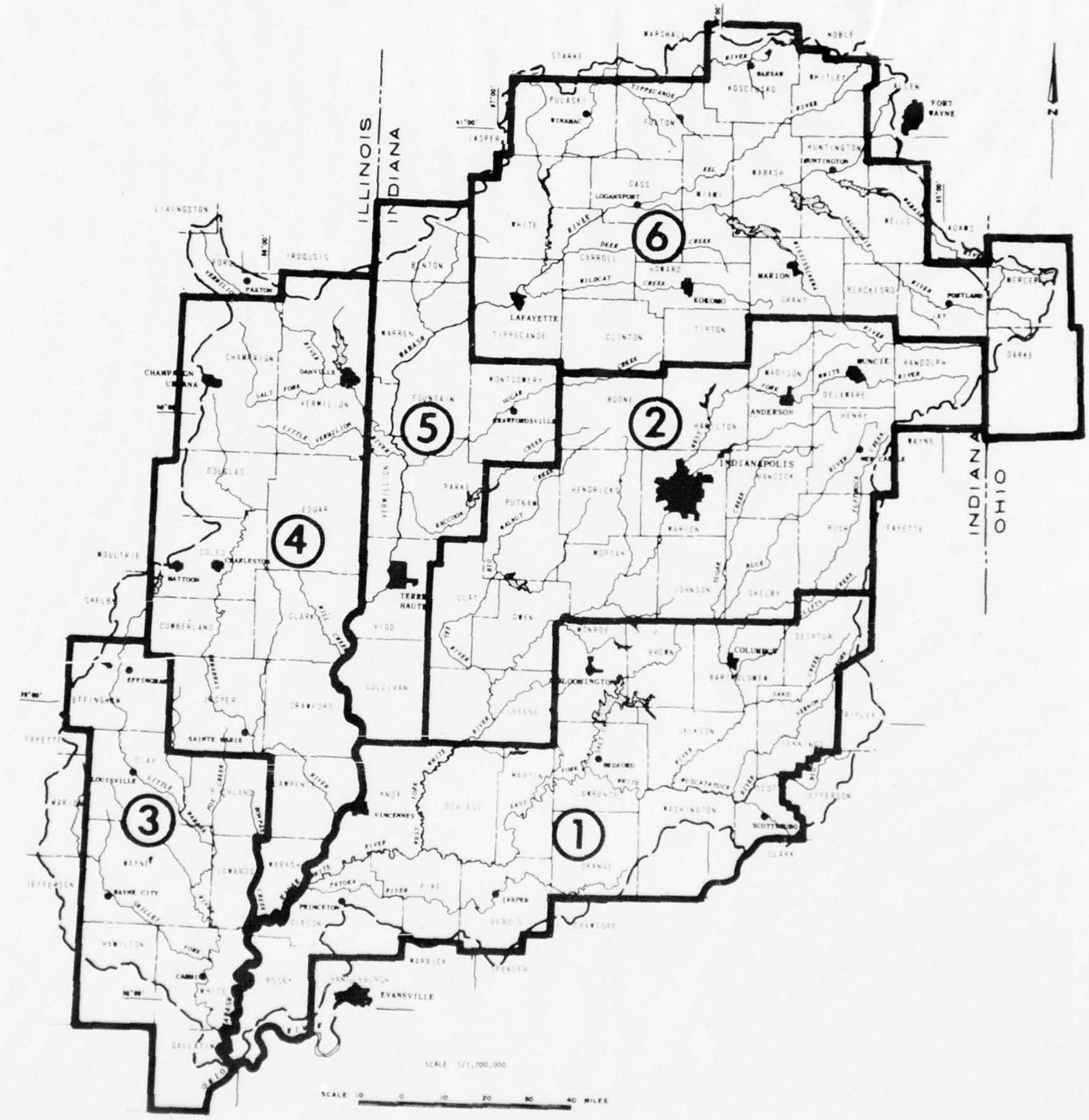


FIGURE 25. TURKEY RUN STATE PARK



ECONOMIC SUBAREAS

FIGURE 26

SECTION III – ECONOMIC ENVIRONMENT

The water resources with which this investigation is concerned are those within the geographic boundaries of the Wabash River basin. However, the service or market area for products of some of these resources such as municipal and industrial water supply is limited only by the practical aspects of the distribution systems. For recreation and other products that may be used by mobile consumers, the market area extends far beyond the Basin's boundaries.

The study area, previously depicted in figure 8, consists of 81 counties comprising 34,572 square miles, including 60 counties in central and southern Indiana totaling 24,160 square miles, 19 counties in southeastern Illinois having 9,353 square miles and two counties in extreme west central Ohio with 1,059 square miles. The 81 counties of the basin were grouped into the six economic subareas shown in figure 26. A determination of the counties included in the six areas, each of which approximates the principal drainage basin of one or more hydrologic subbasins, were made through formal action by the Wabash River Coordinating Committee.

HISTORICAL BACKGROUND

General

Settlement of the basin generally paralleled development patterns that occurred throughout the Middle West during the late 1700's and early 1800's. Shortly after the War of 1812, Indiana and then Illinois became states – Indiana in 1816 and Illinois in 1818. Ohio was admitted to the Union in 1803. Despite statehood, Federal influences remained very significant especially through the 1830's. The Basin was much affected by developments concerning the Indians and public lands. For instance, the liberal grant of land to Indiana in 1827 for use in constructing the Wabash and Erie Canal was an important inducement to the growth of settlements and towns along and near the Wabash River, especially between Terre Haute and Fort Wayne. On the other hand, the prolonged negotiations which ensued before the Miami Indians could be persuaded to surrender various tracts in the upper Wabash valley tended to retard the settlement and advance of this portion of the valley.

People

Pioneers, followed closely by westward moving settlers, entered the area via the Great Lakes Regions on the north and the Ohio River Valley to the south, and migrated internally along the watercourses of the Wabash and its tributary rivers. Homesteads were first established in the valley portions, spreading gradually onto the surrounding uplands until, by 1900, the areas most suited to agricultural production were largely occupied and the farm population became relatively stationary. Significant population increases since 1900 have come primarily to the Basin's urban areas where commercial and industrial expansions afforded greatest economic opportunities for more and more people.

TABLE 5

POPULATION GROWTH
1790–1900

State	1790	1800	1850	1900
Illinois	–	2,400	851,000	4,821,000
Indiana	–	5,600	988,000	2,516,000
Kentucky 1/	74,000	220,000	982,000	2,147,000
Ohio	–	42,000	1,980,000	4,158,000

1/ Shown for comparison.

The Basin gained in population decade by decade so that by 1860 it ranked among the populous areas of the Union. Much of this growth resulted from immigration, but with each passing decade the increase arising from the area's natives accounted for an enlarged proportion of the gain. For every decennial census through 1850, Ohio and Indiana exceeded Illinois in population; by 1860 Illinois had forged ahead of Indiana and by 1890 ahead of Ohio.

The population of both states was overwhelmingly rural in the pioneer era and, as measured by Federal census returns, almost entirely so until the 1830's. Numerous villages and small towns had existed from frontier days and rising urban population remained widely diffused among numerous towns and cities of modest size. In 1860 the largest town in the Wabash Basin, Indianapolis, had a population of less than 19,000.

TABLE 6

BASIN URBAN GROWTH
1840–1900

Illinois	1840	1860	1880	1900
Champaign	—	1,727	5,103	9,098
Danville	—	1,632	7,733	16,354
Mattoon	—	1,965	5,737	9,622
Urbana	—	—	2,942	5,728
Shawneetown 1/	862	1,115	1,851	1,698
Indiana	**1840**	**1860**	**1880**	**1900**
Anderson	—	2,587	4,126	20,178
Evansville 1/	—	11,484	29,280	59,007
Indianapolis	2,692	18,611	75,056	169,164
Kokomo	—	1,040	4,042	10,609
Lafayette	1,570	9,387	14,860	18,116
Logansport	—	2,979	11,198	16,204
Marion	—	2,628	3,182	17,337
Muncie	—	1,782	5,219	20,942
New Albany 1/	4,226	12,647	16,423	20,628
Terre Haute	—	8,594	26,042	36,673
Vincennes	—	3,960	7,680	10,249

1/ Not in Basin - among oldest settlements

Industry

Isolation and self-sufficiency were fundamental and continuing characteristics of pioneer life. Inasmuch as the pioneers had migrated beyond the limits of an established and developed society, they were short on transportation facilities and largely dependent upon family and neighborhood resources in efforts to satisfy their needs. Much of the greater portion of the food, clothing, and shelter – all essential to survival – were produced within the family or the neighborhood. Moreover, grist mills, saw mills, general stores, blacksmith shops, schools, newspapers, libraries, churches, and the like, whenever they existed, developed almost entirely within small neighborhoods. The pioneer economy was based predominately on agriculture. Corn, the leading crop, was especially suited to the climate and soil of the basin. Other important field crops were wheat and oats and to a lesser extent, rye, buckwheat, flax and barley. Manufacturing was mainly dependent upon and largely subordinate to agriculture. From neighborhood and household processes came meat, butter, candles, soap, woolens, carts, furniture, axes, rail fences, log cabins, and the like.

History substantiates the development patterns of the basin to be characterized by economic expansion with ensuing social adjustment and change. Like the nation as a whole, it has experienced significant economic growth with each passing decade and, in the process, has undergone a gradual transition from initially an extractive-type economy throughout the 1800's to a processing and service-type economic base by the middle 1900's. Relative shares of the Basin's growing labor force and capital resources have in recent decades shifted heavily to economic activities in manufacturing, construction, trade, and public and private services, while progressively fewer people and proportionately less of the mounting capital investments each year are directly engaged in farming pursuits. Many things, including the increasing mobility of labor, advances in technologies, education and specialization, and the vertical and horizontal integrations of capital and management have served the growing populace of the Wabash Basin to produce ever increasing amounts and kinds of goods and services, and to change from principally a rural society to one of an urban-suburban identity.

From the earliest days, the abundancy of water and other natural resources in the Wabash Basin has afforded its inhabitants comparative economic advantages, such as fertile lands for a strong agricultural base and the energy fuels essential to industrial development, coal and petroleum. The availability of oil, natural gas, and a wide variety of mineral deposits including limestone, clay, gypsum, calcareous marl, sandstone and sand and gravel has also played a vital role in the Basin's

TABLE 7

BASIN LEADING INDUSTRIES
(1870–1920)

1870	1880
Flour Products	Flour Products
Lumber	Meat Packing
Woolen Goods	Lumber
Carriages	Foundary Products
Furniture	Railroad Cars
Forges and Rolled Iron	Iron and Steel Products
Pork Packing	Agricultural Implements
Iron Casting	Carriages
1900	**1920**
Meat Packing	Iron and Steel Products
Flour Products	Railroad Cars
Lumber	Automobile Bodies
Liquors	Automobiles
Iron and Steel	Furniture
Foundary Products	Electrical Machinery
Glass	Agricultural Implements
Carriages	Glass

overall development. In fact, the locations, quantities, and quality of the natural resources have been determinant factors in shaping community development throughout much of the Wabash Basin area.

CURRENT ECONOMIC PATTERNS

Introduction

The economic patterns of an area are influenced primarily by available natural resources, its population, labor force, capital resources and the efficiency with which these elements are combined within the framework of the total economic base. The economic studies for this report were designed to furnish guides for identifying and assessing the Basin's economic patterns, potential and growth in relation to water needs. The following paragraphs are a summary of this work.

Population

The total population of the basin has been increasing steadily each decade for two centuries, but at a less rapid rate than the population growth of Illinois, Indiana and Ohio, or the nation as a whole. While total inhabitants of the study area grew from some two million to about three million, or fifty percent, between 1900 and 1960, the nation's population increased from eighty million to one hundred and eighty million – an increase of one hundred and twenty-five percent.

The study area contained about 2,580,000 people in 1940 and 3,250,000 in 1960. This increase in total population was accompanied by increased urbanization from approximately 1,264,000 to 1,820,000 people in the same period. Generally, the trend to urbanization resulted from a period of industrial expansion that occurred during the 1940's and 1950's. The greater employment opportunities offered by industrial expansion caused migrations to the urban areas which in turn created manifold increases in services, trade, housing and other consumer oriented industries in the metropolitan centers. At the same time, increased mechanization of farm operations, with a resulting decline in farm employment and the absence of alternative rural employment opportunities, contributed to rural out-migration and urbanization trends. The rural population in the study area increased from 1,316,000 people in 1940 to 1,430,000 in 1960, but on a percentage basis, it declined from 51 percent of the Basin's total in 1940 to 44 percent in 1960. Historical populations of the United States, Wabash Basin, and the Economic Subareas are shown in figure 27.

Employment

From early settlement days to the period of the 1930's, most of the Basin's labor force was employed in agriculture and agriculturally oriented enterprises. By 1930, manufacturing had begun to make inroads in total employment, particularly in the larger cities and towns. However, it wasn't until the mid-1940's that manufacturing expanded geographically and economically throughout most of the study area.

Total employment increased from 847,400 in 1940 to 1,196,000 in 1960, while unemployment declined from 14 to 5 percent during the same time span. The impact of industrial expansion on the Basin's economy is indicated by comparing agricultural employment with nonagricultural employment during the period 1930 to 1940 – non-agricultural employment increased 57 percent, whereas agricultural employment decreased 55 percent. During the period 1940 to 1960, there were 188,000 people employed in various forms of agriculture, forestry or fishery endeavors while about 187,000 people were employed in the manufacturing industry; by 1960, the number of people engaged in agricultural employment had decreased to 103,800 while the number working in the manufacturing industry had increased to 364,300. A comparison of 1960 employment for the nation and the Basin is shown in figure 28.

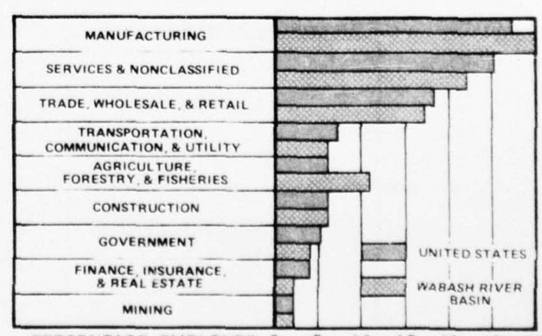
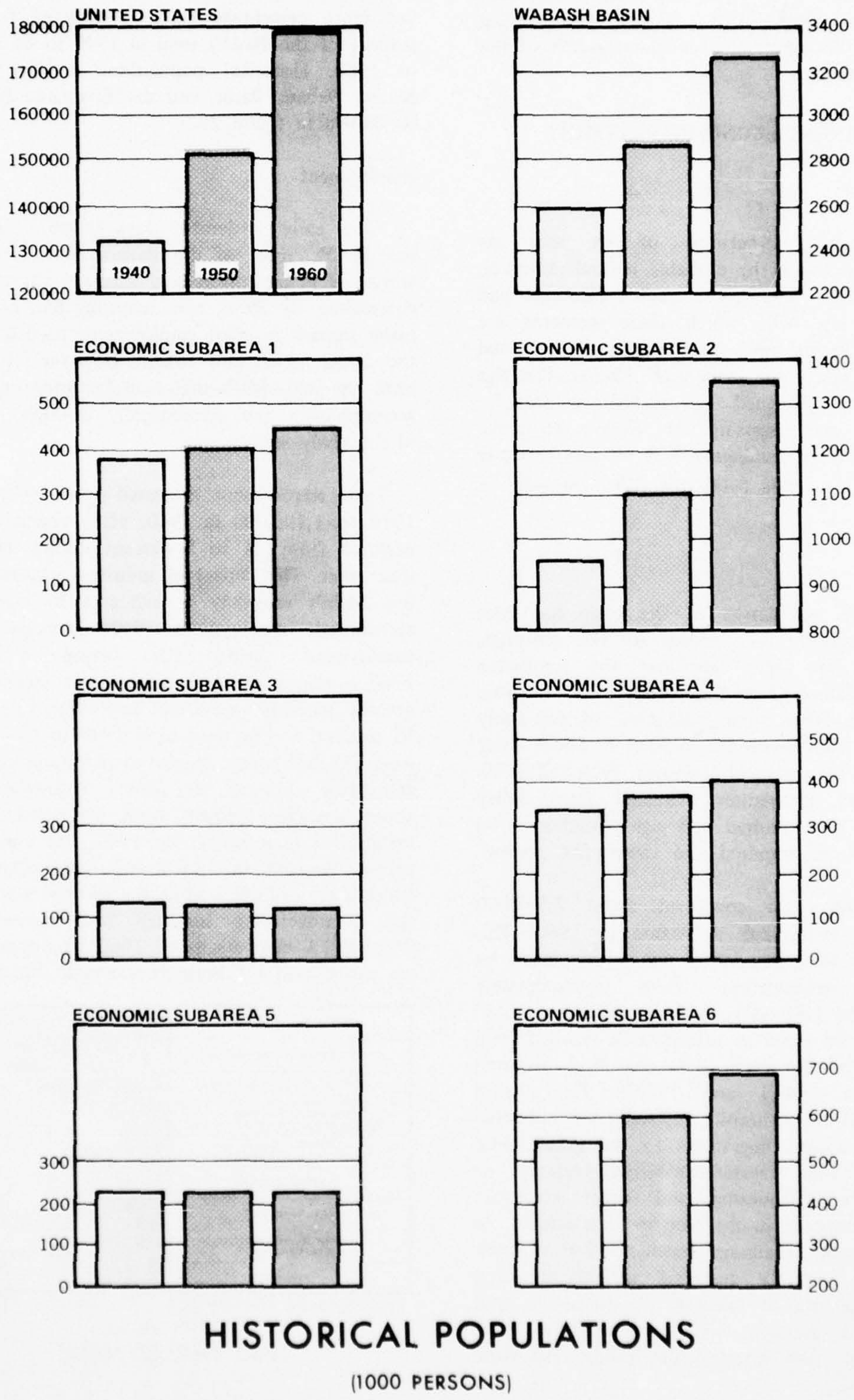


FIGURE 28
1960 EMPLOYMENT



HISTORICAL POPULATIONS

(1000 PERSONS)

FIGURE 27

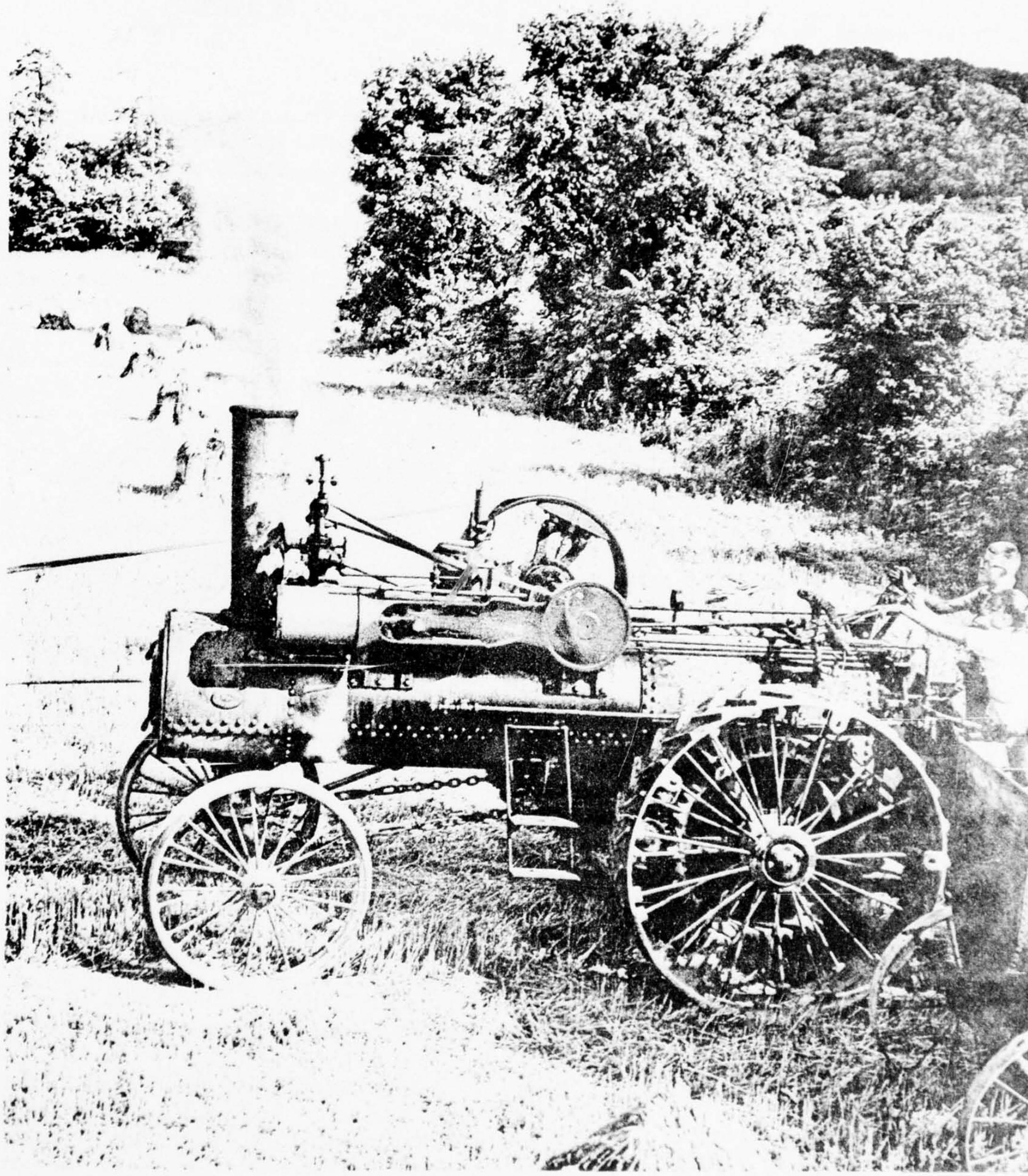


FIGURE 29. DURING THE EARLY 1900's STEAM TRACTORS WERE A COMMON SCENE THROUGHOUT THE GRAIN-FARMING AREAS OF THE BASIN

Personal Income

On the national level, total personal income measured in billions of constant 1958 dollars was 157 in 1930, 172 in 1940, 274 in 1950 and 380 in 1960, an average annual increase of 4.7 percent over the thirty-year span.

For the study area, personal income statistics by counties are generally unavailable, but some meaningful comparisons and influences can be derived from aggregate income data which are available. Figure 30 presents per capita personal income levels, 1940 through 1960, for the United States and selected economic areas. Most notable are the concentrations of aggregate income, 47 percent of the study area's total in 1960, in Economic Subarea No. 2, comprising the Indianapolis socio-economic area. By contrast, the predominately rural Economic Subareas Nos. 3 and 5 had approximately 3 and 7 percent, respectively. Economic Subareas Nos. 1, 4, and 6 had 11, 12 and 20 percent of the total aggregate income in 1960.

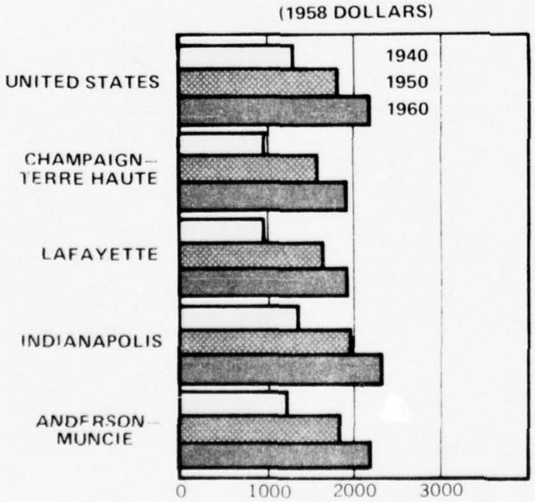


FIGURE 30

PER CAPITA PERSONAL INCOME 1940-1960 UNITED STATES AND SELECTED ECONOMIC AREAS

CURRENT ECONOMIC ACTIVITIES

Land

Land is the keystone of most economic activity within the basin. In 1968, 89 percent of the Wabash land was classified as agricultural. About 64 percent of this was actual cropland, 15 percent was in forest land, and the balance was used for other agricultural and non-agricultural uses. The total study area land use for 1968 is illustrated in figure 31.

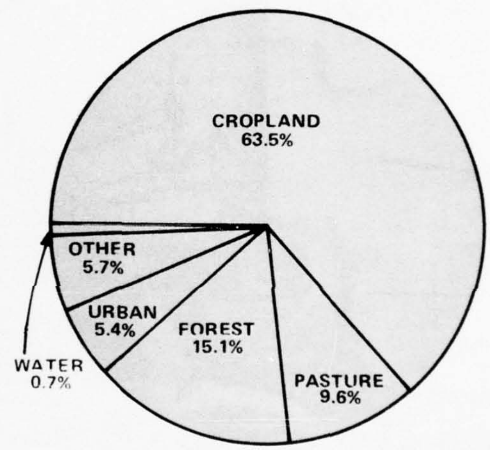


FIGURE 31

1968 MAJOR LAND USE

Agriculture – Crops, Livestock and Forestry

It was established early in this section that the study area has been and remains heavily oriented toward agriculture. The central part of the basin contains two types of farming areas: cash grain and diversified livestock farming, characterized by prairie type soils suitable for highly mechanized cultivation. This area represents the eastern portion of the corn belt with emphasis on cash crops such as corn, soybeans and wheat and the fattening of livestock for market. In the lower reaches of the river, corn, wheat and truck farming are predominant. The growing of such crops is often

coincident with sandy or alluvial soils on the flood plains with some fruit and truck crops being grown on the sandy ridges. The extreme southwestern and southeastern portions of the basin fall into the general farming category. The East-central Indiana enterprises are corn, wheat, and hog farming. Wheat is the cash crop and a large measure of the corn is marketed through the hog operation. In the northern portion, dairying and general farming prevail; it is in this area that milk is the most important cash commodity and sheep are found here more than other subareas. Summarizing, the three major crops produced in the study area are corn, soybeans and wheat. Other crops include oats, barley, rye, hay, miscellaneous vegetables, potatoes and fruit orchards. The total value of all crops in the study area in 1964 was $550 million.

Livestock and livestock product sa represented about 50 percent of all farm recei in 1964. Cattle and/or calves and hogs were principal livestock items; Economic Subareas 2 a 6 contributed nearly 50 percent to the volume cattle sales throughout the basin. Hay producti is even more heavily concentrated in these t subareas. These same subareas provide 60 perc of the Basin's milk output. Egg production w heavily concentrated in Economic Subareas 1 a 6 in 1964 with only slightly over 30 percent the Basin's output from other subareas. Broil and turkeys were more unevenly distributed w Economic Subarea 1 having over 70 percent of 1964 production. The value of all livestc products sold in the study area in 1964 was o $500 million. Over 50 percent of this amount w produced in Economic Subareas 2 and 6.

FIGURE 32. CORN IS THE MOST IMPORTANT CROP AND WHEAT IS THE MAJOR SMALL GRAIN GROWN IN THE WABASH BASIN

Forest lands comprise about 3.4 million acres or 15 percent of the Basin's 22 million acres total. Ninety-eight percent of this forest area is classified as commercial forest, or land that is producing or has a potential of producing crops of industrial wood and is not withdrawn from timber utilization. The percent of forest area by county is presented in figure 33. Approximately 60 percent of the forest land is found in and near the East and West Forks of the White River, Economic Subareas 1 and 2.

Commercial forest stands now contain about 1,600,000 acres of sawtimber, 1,100,000 acres of poletimber, 524,000 acres of seedlings and saplings, and 69,000 acres of non-stocked timber. Products from forests in the basin are marketed principally through the primary wood using industries of the area. These are comprised of 375 primary wood-using plants including 334 sawmills three pulp and paper mills; 14 veneer mills. 8 handle plants, 10 cooperage plants, and 6 non-classified industries. The 1962 production involved a timber cut of over 130 million board feet.

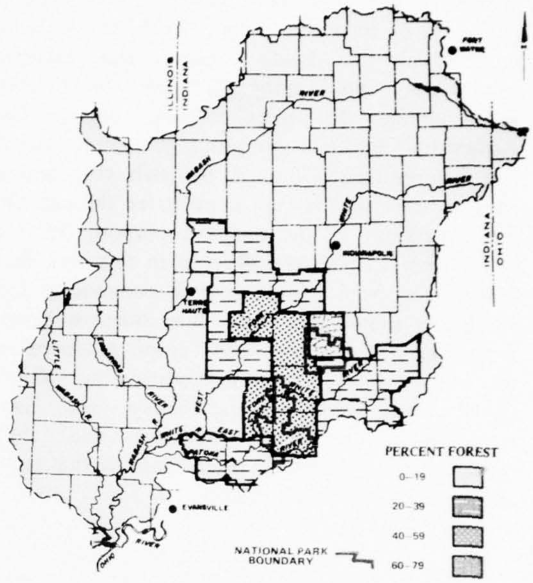


FIGURE 33

FOREST INVENTORY

FIGURE 34. PROPER FOREST MANAGEMENT WILL INCREASE VALUES, VOLUME AND PRODUCTIVE CAPACITY OF THE BASIN'S FOREST LANDS

Mining

The extraction of mineral resources is concentrated in the southwestern portion of the basin where bituminous coal and petroleum predominate. However, some mining activities can be found throughout the basin but in fewer number, (figure 35). The principal mineral resources of the valley are coal, petroleum, natural gas, sand, gravel, clay, shale, stone and gypsum. Mineral producers ship coal, petroleum, dimension stone and gypsum to markets outside the basin Most of the sand, gravel, clay, shale, and crushed stone is sold and used near the source of production.

The total value of Wabash mineral output was nearly $356 million in 1960 and $315 million in 1965, table 8. The value of the major mineral production, petroleum, coal, crushed and dimension stone and sand and gravel, accounted for 90 percent of the basin total with petroleum contributing 52 percent and coal over 17 percent in 1967.

At the end of 1960, a total of 349 mineral producers were active excluding petroleum, natural gas, clay and marl producers. Of the 349 producers, 179 were in sand and gravel, 71 coal, 72 crushed stone, 18 dimension stone, 7 peat and 2 gypsum. Mineral industry employment totaled about 12,000; two-thirds of the people were employed in the petroluem and coal industries.

Manufacturing

More than any other factor, manufacturing has caused the concentration of people and the corresponding trade, service and construction activities in dispersed small areas of the basin, even though the principal cities were established earlier. In terms of both employment and production, agriculture is second to manufacturing as the Basin's most significant economic activity. The heaviest concentration of industrial workers and plants is in east-central Indiana where about two-thirds of the Basin's total employment in manufacturing is found. Specifically, the major manufacturing centers are located in and around Indianapolis, Anderson, Marion, Kokomo, Muncie, and Terre Haute, Indiana and in Danville and Champaign-Urbana, Illinois. Primary production includes machinery, chemicals, fabricated metal

TABLE 8

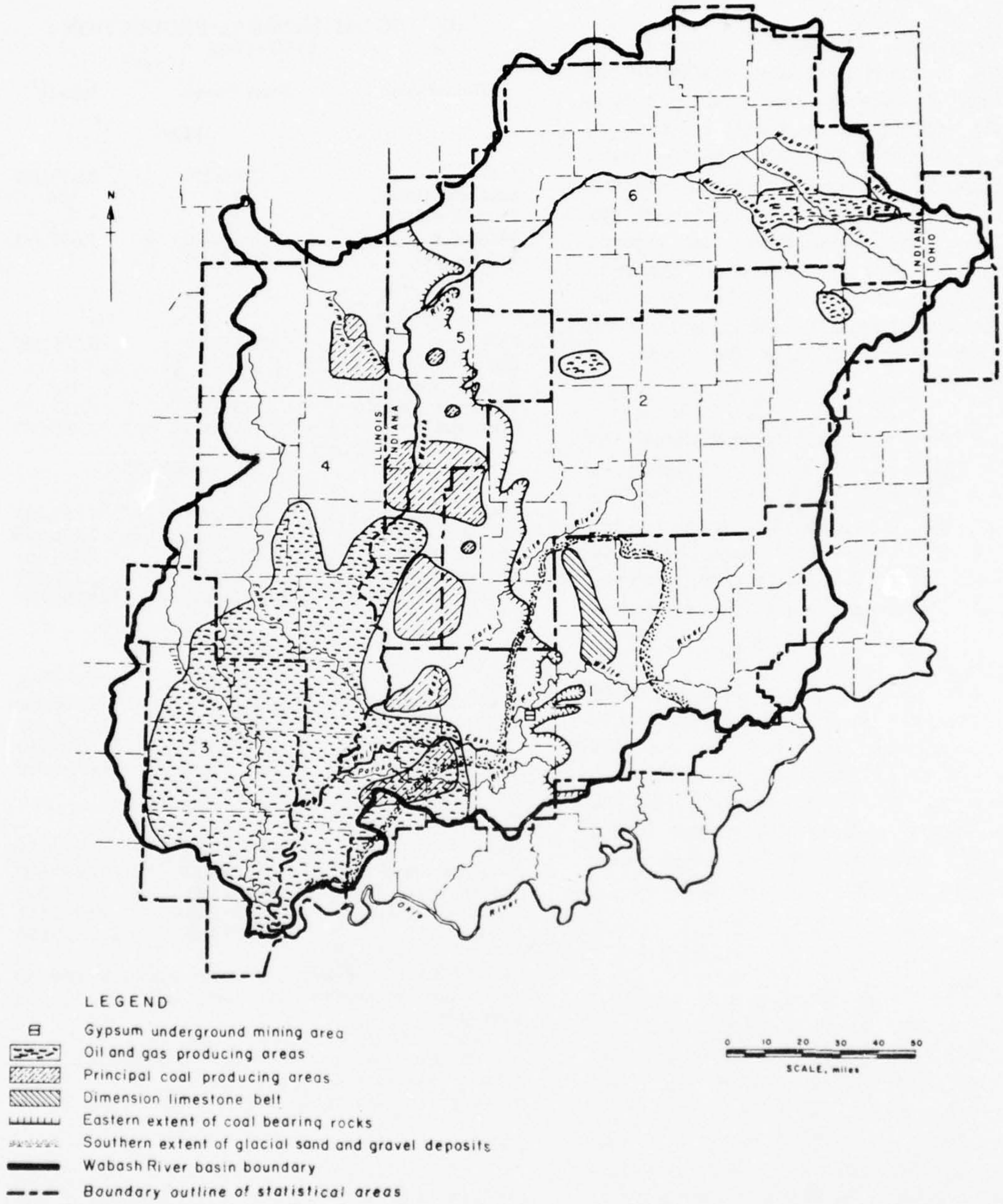
HISTORICAL MINERAL PRODUCTI
1900–1965

Commodity	Short Tons 1/	V
	1900	
Coal	8,118,750	8
Sand and Gravel	N.A.	
Crushed Stone	N.A.	
Dimension Stone 3/	510,000	1
Petroleum 4/	4,874,000	
	1920	
Coal	31,244,689	96
Sand and Gravel	N.A.	
Crushed Stone	N.A.	
Dimension Stone 1/	459,765	7
Petroleum 4/	11,719,000	42
	1940	
Coal	19,290,587	30
Sand and Gravel	4,806,404	2
Crushed Stone	2,889,343	2
Dimension Stone	247,982	2
Petroleum 4/	152,625,000	161
	1960	
Coal	11,562,235	48
Sand and Gravel	16,971,663	14
Crushed Stone	14,401,404	18
Dimension Stone	528,855	11
Petroleum 4/	89,395,000	264
	1965	
Coal	10,610,349	42
Sand and Gravel	20,050,000	17
Crushed Stone	18,202,299	24
Dimension Stone	455,659	10
Petroleum 4/	75,189,000	219

1/ Production as measured by mine shipments, marketable production (including consumpt producers).
2/ Value in dollars, f.o.b. mine or plant.
3/ Date from 1900 through 1935 represent Lawr Monroe Counties, Indiana, only.
4/ Data for total production of Indiana and combined, in barrels.
N.A. – Not available.

products, automotive and electrical equipm supplies.

Value added by manufacture in the stu has risen sharply since 1954, increasing fro 2.3 billion to over 4.1 billion dollars ann 1963. This 77.4 percent increase in nin compares with a 64.5 percent increase nation and comparable percentage increa Illinois, Indiana and Ohio of 51.4, 67.1, an



PRINCIPAL MINERAL PRODUCING AREAS IN THE WABASH RIVER BASIN

FIGURE 35

respectively. During this same period, the Indianapolis trade area, comprising Economic Subarea No. 2 had 2,104 million dollars in value added by manufacturing which was more than half of the study area total. Two other major concentrations of value added by manufacture, Economic Subareas Nos. 1 and 6, had increases from 1954 to 1963 of 118 and 117 percent, as shown in table 9 below.

TABLE 9

VALUE ADDED BY MANUFACTURING
1954 AND 1963

Area	Value Added 1954	Value Added 1963	Increase 1954–63
	(Millions of Current Dollars)		(Percent)
United States 1/	116,915	192,330	64
Illinois	9,669	14,640	51
Indiana	4,626	7,726	67
Ohio	10,165	15,506	52
Wabash River Basin	2,339	4,148	77
Economic Subarea No			
1	243	530	118
2	1,345	2,104	57
3	17	34	100
4	154	286	86
5	119	192	62
6	461	1,002	117

1/ Excludes Alaska and Hawaii.

Public Utilities and Transportation

Of the utilities in the basin, the electric power industry has had the greatest overall impact. In 1965 the electric power requirements were supplied by 96 utilities located either partially or totally within the Wabash Power Region. Ownership of these systems was as follows: municipal – 58, cooperative – 31, and investor owned – 7. All three ownership categories had system requirements within the Power Region exceeding their actual energy generated.

Steam-electric plants, using coal or natural gas as fuel, generate the major portion of electric energy produced. As of 1969 there were 25 steam-electric plants ranging in size from 5,750 to 962,000 kilowatts of capacity; 15 internal combustion and gas turbine plants which range from 850 to 104,500 kilowatts of capacity; 3 hydroelectric plants which range from 384 to 11,000 kilowatts of capacity.

The Wabash River basin ar
regions generally are well
transportation facilities. Acces
seven Interstate highways, 17
numerous state and local roa
roads are in various stages of
the National System of Inter
Highways; seven Interstate
Indianapolis – more than an
city. The excellent network of
highways facilitated the opera
8,000 trucking companies lice
commerce in Indiana and Illinoi

Rail traffic funnels across th
lines between the Great Lakes
the Ohio River in the south.
concentrations of rail lines in
north of the basin in the n
Illinois and Indiana.

Airports are available at the
in and adjacent to the basin. C
commercial passenger and frei
Champaign, Danville and Ma
Indianapolis, Bloomington, C
Lafayette, Marion, Muncie,
Indiana. Principal airlines ser
American, Eastern, Delta, Tra
Ozark and United. Jet flying tin
or Springfield to New York or
over an hour and one-half.

An extensive network of
area. Pipelines are used
distributing natural gas and
transporting crude oil to re
terminals.

Incoming natural gas is supp
companies over long distance
Gulf states, southwestern a
Distribution companies have a
capacity and many are now
storage facilities where surfac
peak winter withdrawal.

The pipelines used for mo
refineries to distribution cen
important factor in the tran
however, since they are lim
movement of liquids and ga

satisfy a small field of the total transportation requirements.

Waterway navigation along the Wabash and its major tributaries is practically non-existent, as there are no improved channels except where local or private interests have some limited objective. These interests generally consist of automobile ferries, local sand and gravel barging, and recreational traffic.

Trade and Services

The increase in manufacturing has been accompanied by a significant increase in trade and service activities. Manufacturing is even more concentrated than population, and trade and service activities even more than manufacturing when a representative array of activities is considered.

Table 10 gives a certain perspective to the trade and service increment of the Basin's economy by listing relevant items for the area's ten most populated counties and indicates the relative importance of these counties in the basin.

Retail sales within the basin during 1963 amounted to nearly $4.6 billion, a 43 percent increase over 1954 and 1.9 percent of the national total. The increase was almost parallel to the national retail sales increase of 43.2% over the sa period. Food, automotive equipment, merchandise, gasoline service stations, materials outlets, and eating establishmen the Basin's leaders in sales. In wholesali sales totaling about $5.0 billion or 1.4 pe the United States total, groceries, farm p machinery and equipment, bulk petrole motor vehicles were the leaders. Personal miscellaneous business services and aut repair and services were the leaders in t service industry receipts of about $477 This represented some 1.1 percent of t national receipts from services.

PROJECTED ECONOMY

Background

The activities and developments in the water resources of the Wabash River basin largely upon the economic growth that ma in this segment of the economy. The p paragraphs of this section have presented t of the current economy and the trends growth. These trends when examine projected to the future provide a steppi for viewing the future economy of the st on the basis of present knowledge of fo developments and relationships determinab past experiences. Prerequisite to these pr

TABLE 10

TRADE AND SERVICE
INDUSTRY PERSPECTIVE

County	Value Added by Manufacture 1963	Total Retail Sales 1963	Total Wholesale Sales 1963	Receipts Selected Services 1963	Pc (TI
	(Millions of Dollars)				
Marion, Ind	1,266	1,142	2,648	186	
Champaign, Ill	40	190	263	21	
Madison, Ind	346	182	78	14	
Delaware, Ind	222	153	90	18	
Vigo, Ind	123	192	147	19	
Vermilion, Ill	143	137	103	12	
Tippecanoe, Ind	103	140	65	17	
Grant, Ind	174	108	46	12	
Howard, Ind	234	115	48	9	
Monroe, Ind	118	78	61	8	
TOTAL	2,769	2,437	3,549	316	
Wabash Basin Total	4,148	4,562	4,959	477	
% of Basin	66.8%	53.4%	71.6%	66.2%	

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WABASH RIVER BASIN COMPREHENSIVE STUDY. VOLUME I. MAIN REPORT.(U)

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are certain assumptions, the broader and more general framework assumptions adopted for the projection period, 1980 through 2020, were those usually assumed in most contemporary projective economic base analyses for national, regional and smaller area resources planning and development studies. These assumptions were: (a) that government and private policies will be effective in averting prolonged periods of high unemployment, major recession and inflation; (b) that a global nuclear conflict will not occur; and (c) that relative needs of the domestic economy and the national defense will continue at or near current levels.

Further details on the basic projective assumptions, methodologies and data sources are included in Appendix B, Economic Base Study. An expanded treatment of the mineral and agricultural sectors of the area's economy is presented in the appendices covering these subjects.

National Projections

The changing economy of the nation during the past 70 years, particularly the last 30, has produced specific trends which are expected to continue into the future. These trends on a national basis can be traced to increased production efficiency arising from technological progress, a high rate of capital input, development of natural resources, a mobility of the work force, educational advances and the economics of mass production. Because the foregoing intrinsically complex factors affect the national economy, the Water Resource Council requested that the Office of Business Economics and the Economic Research Service (abbreviated OBERS) jointly conduct a nationwide study to provide demographic and economic projections for official use in connection with water resources planning. The OBERS projections were first issued in 1968; throughout this report, national economic projections were extracted from this and later data provided.

Recent OBERS projections (1969) incorporate the following average annual growth rates: total population – 1.3 percent; average production per manhour – 3.0 percent; and Gross National Product – 4.0 percent. The following table 11 summarizes the national projections.

Wabash River Basin Projections

Past Trends and Projections

Historically, the Wabash Basin's economic development has followed a pattern generally similar to that of the nation as a whole. An important difference, however, is that the typical transitions from extractive to processing and service type economic activities have not been at all uniform. As a result, this relatively small area within the nation is somewhat unique in its wide latitude of economic growth to date.

TABLE 11

SUMMARY NATIONAL PROJECTIONS 1/

Item	1960	1980	2000	2020
		(Thousands of Persons)		
Population	179,323	234,193	306,757	397,562
Employment	66,373	92,712	122,663	159,178
Agriculture, Forestry & Fisheries	4,470	3,271	2,505	1,897
Mining, Coal & Other	675	607	589	577
Construction	3,968	5,719	7,516	9,690
Manufacturing	18,245	23,392	28,275	34,366
Transportation & Communication	4,651	5,149	5,413	5,602
Trade, Wholesale & Retail	12,288	16,483	20,834	25,953
Finance, Insurance, Real Estate	2,820	4,319	6,054	8,203
Services	14,124	26,268	41,179	59,529
Government, Civil & Military	5,132	7,504	10,298	13,361

1/ Includes Alaska, Hawaii and 48 contiguous states

Throughout the nation, major economic developments and population increases are occurring primarily in the larger cities, of which the Wabash Basin has but one. Indianapolis and immediate vicinity, accounting for about one-third of the Basin's 3.2 million population in 1960, is the only area having more than 100,000 people. Being virtually surrounded within a 200-mile radius, by metropolises such as Chicago, St. Louis, and Cincinnati, and several smaller urban areas ranging from 100,000 to 500,000 population, the basin has been nearly bypassed so far in terms of its vast economic potential. However, because of this proximity to major urban areas, industrial-commercial complexes are being located in the basin within the mainstem of the nation's interconnecting transportation routes. This should result in a substantially greater share of economic growth in the future.

Past trends indicate that differential growth will probably characterize development of the Wabash Basin's economy for many years to come. However, increasing agricultural output and an expanding manufacturing base will likely continue, serving to close the gaps between the lagging areas and its more progressive ones. Some of the growing and more promising industries of the future are already making significant inroads within the region. Absolute population increases are being registered where such manufacturing, processing and services industries have located. In addition to the existing facilities for future expansions, the Basin also has the potential, with its abundant coal and water resources, of becoming one of the nation's major electrical power supply areas as well as a prime exporter of coal to other parts of the country.

The actual social and economic future is, of course, unknown at this time. Still, some reasoned insight into the nature and extent of future economic activities is necessary in order to intelligently make plans for the amounts, kinds, and timing of supporting water resource developments needed. Since water needs are generated largely from population growth, economic growth, and changes in technologies, such insight can be gained by the use of appropriate projections that are made available at the time of planning.

TABLE 12

SUMMARY WABASH BASIN PROJECTIONS

		1960	1980	2000	2020
			(Thousands of Persons)		
TOTAL POPULATION		3,250.3	4,249.9	5,469.4	6,380.7
Urban	(%)	(56)	(59)	(61)	(62)
Rural	(%)	(44)	(41)	(39)	(38)
TOTAL LABOR FORCE		1,256.3	1,711.3	2,233.4	2,642.1
Employed 1/	(%)	(95)	(95)	(95)	(95)
Unemployed	(%)	(5)	(5)	(5)	(5)
TOTAL EMPLOYMENT		1,196.4	1,614.1	2,107.7	2,495.5
By Industries:	SIC				
Agriculture, Forestry and Fisheries	A	103.8	82.4	61.6	43.9
Mining, Coal and Other	B	13.4	12.2	10.8	10.5
Construction	C	60.9	85.9	120.5	153.2
Manufacturing	D	364.3	486.6	602.4	699.3
Transportation and Communication	E	77.2	101.9	127.3	148.5
Trade, Wholesale and Retail	F	214.5	316.9	417.7	483.1
Finance, Insurance and Real Estate	G	40.3	75.3	108.4	124.0
Services 2/	H&J	275.1	377.4	526.2	645.2
Government, Civil	I	46.9	75.5	132.8	187.8

1/ Includes Armed Forces
2/ Includes educational services and nonclassified employment

To provide guides for appraising future growth in relation to water and land requirements, the economic base study for this report was prepared. A summary of economic base data and projections is given in table 12. The base study embraces the total subject area comprised of six economic subareas. As such, it establishes quantitative benchmarks for the detailed planning studies within the individual subareas, tributary to the Wabash River.

Population

The population of the basin was projected to the year 2020 as a basic guide for resource development and preservation. Area population projections reflect projection of the national population and an analysis of historical trends, current trends and the latent economic potentials. A population increase at a rate similar to the nation is projected through 1980, and thereafter the rate is expected to decrease to about half of the national rate by 2020. The rural farm population is expected to continue to decrease; rural non-farm population will also decrease but at a lesser rate toward the end of the projection period.

Three-fifths of the population will be urban by 1990. The population of the six Standard Metropolitan Statistical Areas is expected to comprise about 46 percent of the total Wabash River basin population by 2020. Growth is projected to be most rapid in the Anderson, Lafayette-West Lafayette, and Muncie areas. Historical and projected population characteristics are presented in table 13 and illustrated in figure 36.

TABLE 13

POPULATION PROJECTIONS (1,000's)

Area	1960	1980	2000	2020
Wabash Basin	3,250	4,250	5,469	6,381
Subarea No				
1	436	686	953	1,166
2	1,365	1,740	2,235	2,557
3	119	149	195	241
4	404	480	584	681
5	234	259	310	339
6	691	928	1,191	1,394

Employment

Employment patterns in the study area have tended and will probably continue to parallel those of the nation. In this parallelism the Basin's economy is undergoing significant major changes which are affecting its overall employment pattern. Employment is projected to rise from the 1.2 million in 1960 to about 1.6 million in 1980, 2.1 million in 2000 and 2.5 million by 2020, more than doubling over the 60-year period. The four industries – agriculture, mining, construction and manufacturing – considered as the major water using industries, accounted for about 50 percent of total employment in 1960. By 2020 it is estimated that these four industries will require a lesser percentage of the projected total employment sector, about 37 percent. By way of comparison, the total employment in the service

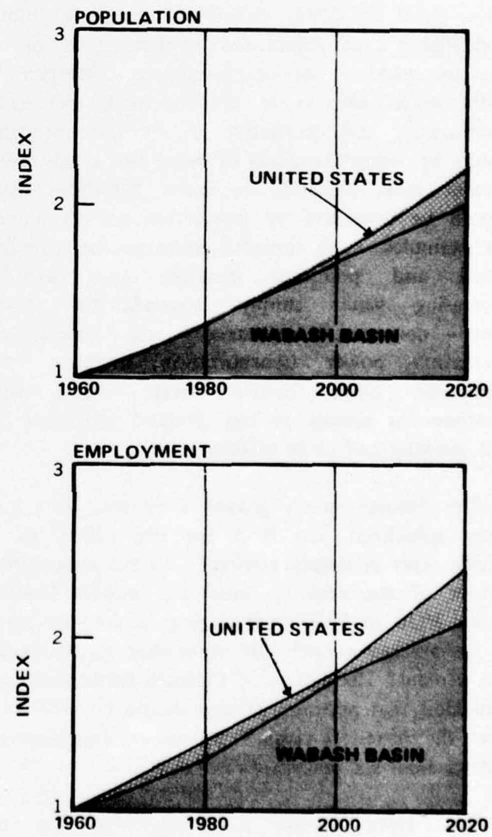


FIGURE 36

NATIONAL AND STUDY AREA PROJECTION COMPARISONS

area in 2020 is expected to be triple that of 1960, whereas employment in the four industry sectors is expected to be less than twice that of the 1960 level. The most dramatic growth will be registered in the finance and government sectors for which it is estimated that the employment levels will be about four times the 1960 level. A projection of employment is illustrated in figure 36.

Personal Income

On the national level personal income measured in billions of constant 1958 dollars was 157 in 1930; 172 in 1940; 274 in 1950; and 380 in 1960, an average annual increase of 4.7 percent over the thirty-year period. In the Wabash River basin this upward trend in per capita income has been similarily evident, and it is expected to continue into the future. It will also continue to bring mounting pressures on industry and government to satisfy growing demands for more and higher type goods and services. In terms of the end products of water resource developments with which this study is concerned, increasing quantitative and qualitative requirements brought about by rising standards of living will create even greater total demands on water resources than would be generated by population growth alone. As examples, more remedial measures for reducing flood and pollution damages and hazards, increasing water supply demands for many uses – domestic, industrial and municipal, recreation, power, transportation, irrigation and numerous other human needs – these will continue to mount in the demand schedules of our growing and more affluent society.

The Wabash area's growth over the years has been somewhat less than for the nation as a whole. This is largely attributed to the agricultural nature of the area up until the middle 1940's. From 1930 to 1940 total income in the area grew at an average annual rate somewhat in excess of 2½ percent. The Office of Business Economics has indicated that personal income should be projected over the next 50 years at an annual rate slightly greater than six percent.

The more recent trend in the rise of manufacturing earnings as an income source and the decrease of importance of property income indicates an increase of personal income over the projection period. The differentials that existed between the region and more affluent parts of the country will be smaller over the next fifty years. Total personal income for the basin is projected to increase from $3,000 in 1960, to $4,500 in 1980, to $7,500 in 2000 and $13,000 by 2020. During this latter period, it is assumed that expansion of personal income will begin to approximate the national growth rate and achieve the afforementioned level. On a per capita basis the area will continue to exhibit levels lower than the average for the nation over the projection period. Figure 37 illustrates per capita personal income 1960-2020 for the United States and selected economic areas.

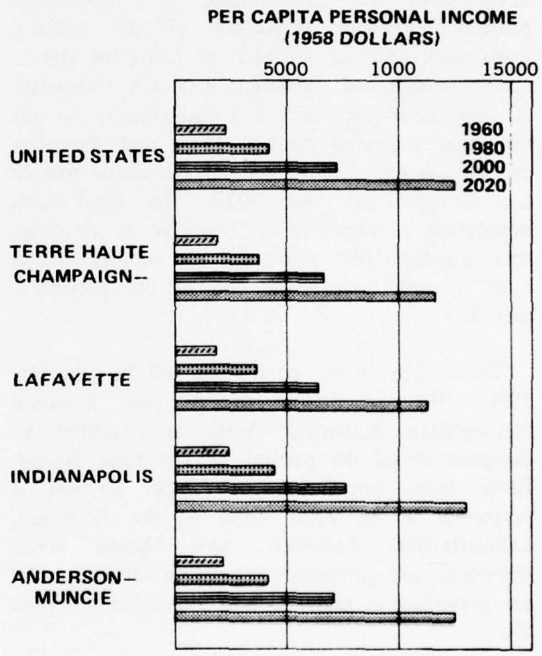


FIGURE 37
PER CAPITA PERSONAL INCOME,

Land Use

The present and projected land use in the basin is illustrated in figure 38. The land area available for crop and pasture use is expected to decline over the projection period due to the expansion in non-farm uses of agricultural land. Land for agricultural purposes will decline from the 16,383,000 acres of 1958 to 15,177,000 acres by 2020. Forest land and the other land uses category were held constant throughout the

projection period under the assumption that those changes that would occur at a particular location would be offset by opposite changes elsewhere. The area of urban land expands to reflect the expected growth in population and its accompanying demands for land. The demand for urban land use was obtained from projections of expected land needs per thousand of increased population considering residential, transportation, and recreational requirements.

Agriculture

The Basin's demands for food and fiber were developed for the years 1980, 2000, and 2020 from the national interregional demand projections for the Ohio River basin. This was done through a detailed evaluation of the historical share of the Ohio Basin production. An examination of table 14 indicates the relative acreage of the Basin's principal crops for 1959, 1980, 2000, and 2020. Corn, the major crop, has a projected acreage for grain and silage of 4,906,300 acres in 1980; 5,423,000 acres in 2000; and 5,635,400 acres in 2020. This represents 37 percent, 40 percent, and 42 percent, respectively, of the cropland in the basin. Soybeans are projected to require 5,086,300 acres in 1980; 5,170,200 acres in 2000; and 5,050,800 acres in 2020. The acreage devoted to other crops is projected to decline with the exception of rotation pasture. The conversion of pasture land to cropland is projected to increase from 84,700 acres in 1980 to 592,700 acres in 2020 reflecting a more intensive utilization of the land resource base. The projected value of all crop and livestock products sold in the study area is estimated to be about 2.5 times the 1959 value by 2020; the 1959 products were valued at \$1.4 billion.

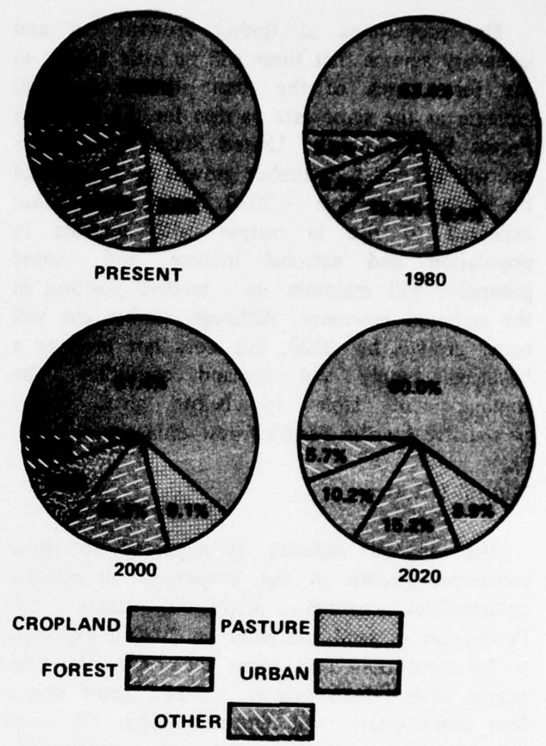


FIGURE 38
LAND USE, PRESENT—2020

Livestock projections reflect the combined influence of historical trends in livestock production within the basin and the predetermined demand for livestock products derived indirectly from the projections of per capita rates of consumption and expected population growth for the nation as a whole. The projected levels of livestock production are indicated in table 15.

TABLE 14

CROP ACREAGE PROJECTIONS
(1,000 Acres)

Crop	1959	1980	2000	2020
Corn	5,319	4,906	5,424	5,635
Soybeans	2,918	5,086	5,170	5,051
Wheat	1,303	1,821	1,737	1,649
Oats	799	342	189	103
Barley	52	20	12	6
Hay	1,171	673	579	472
Other	180	285	218	151
TOTAL	11,742			13,067

TABLE 15

LIVESTOCK PRODUCTION
PROJECTED VALUE
(1,000 Dollars)

Economic Subarea	1959	1980	2000	2020
1	119,595	162,713	220,613	280,582
2	159,093	189,789	262,430	338,251
3	37,593	64,954	90,158	116,158
4	68,381	99,771	138,443	178,138
5	54,062	78,033	108,419	139,759
6	194,416	254,526	350,334	450,715
TOTAL	633,140	849,786	1,170,397	1,503,603

The projections of timber growth, cut and inventory assume that there will be little change in the forest area of the basin; timber cut will increase at the same rate as that for the Northern Forest Region of the United States; and timber cut will be equal to timber growth by the end of the projection period – 2020. Forest products are expected to rise in output with increase in population and national income, and wood generally, will maintain its relative position in the national economy. Although timber cut will equal growth by 2020, this does not indicate a balanced supply and demand condition. The summary of table 16 below gives future perspective for the Basin's forest economy.

Mineral Industry

The mineral industry is expected to show continued growth in the output of all mineral commodities except petroleum, table 17. Production of sand and gravel in 2020 is expected to be more than four times the 1970 rate; coal nearly seven times greater, crushed stone about four times greater and dimension stone 1.3 times the current production. Petroleum production, however, is expected to decline to only eight percent of its 1970 level. Projected water use by the mineral industry through 2020 shows a steady increase of water requirements in all mineral industries except coal and petroleum. The relative amounts used, industry by industry, will remain the same. A decline in water used by the dimension stone and petroleum industries will be offset by increased water use in sand and gravel operations.

TABLE 17

MINERAL HISTORY PROJECTIONS
(One Million Short Tons)

Commodity	1960	1980	2000	2020
Coal	11.6	22.7	33.0	29.0
Crushed Stone	14.4	26.3	44.1	74.4
Dimension Stone 1/	0.5	0.6	0.7	0.7
Sand and Gravel	17.0	32.4	57.9	104.7
Petroleum 2/	89.4	19.4	7.1	2.7

1/ Includes production and employment data for small quantities of dimension stone produced in Subareas 2 and 6 in addition to that shown for Subarea 1.
2/ Thousands of 42 gallon barrels.

TABLE 16

SAW TIMBER – ALL SPECIES ON COMMERCIAL FOREST LAND
(Million Board Feet)

Economic Subarea	Cut	Growth	Inventory	Cut	Growth	Inventory
		1962			1980	
1	43.7	143.9	2,903	73.6	106.2	3,988
2	24.6	80.9	1,633	41.4	59.8	2,244
3	12.9	42.8	869	21.8	31.8	1,194
4	11.8	39.3	798	20.1	29.2	1,096
5	12.9	43.0	873	21.9	32.0	1,200
6	24.3	80.8	1,638	41.2	60.0	2,250
TOTAL	130.2	430.7	8,714	220.0	319.0	11,972
		2000			2020	
1	118.4	131.2	4,353	147.8	147.8	4,442
2	66.6	73.8	2,448	83.2	83.2	2,499
3	35.4	39.3	1,303	44.3	44.3	1,330
4	32.5	36.1	1,197	40.7	40.7	1,221
5	35.5	39.5	1,309	44.5	44.5	1,336
6	66.6	74.1	2,456	83.5	83.5	2,506
TOTAL	355.0	394.0	13,066	444.0	444.0	13,334

Subarea Projection

Subarea projections were made for each of the six Economic Subareas to facilitate an orderly and efficient analysis of water and related land resources needs. Each subarea was delineated along county lines approximately the physical drainage area of a principal tributary or a major reach of the mainstem of the river. To further serve planning requirements for utilizing economic base data in workable subregions, the multi-county hydrologic subarea definitions were adjusted, insofar as practicable, to conform to the existing socio-economic patterns. A summarization of the economic base data and projections thereof, 1940 through 2020, for each of the subareas is given in table 18.

TABLE 18

SUMMARY OF ECONOMIC SUBAREA PROJECTIONS
(Thousands of Persons)

Area	Population	Labor Force	Employment	Population	Labor Force	Employment
		1960			1980	
Economic Subarea						
1	436.4	161.3	152.7	685.5	271.0	255.4
2	1,365.7	549.8	525.3	1,740.0	713.8	675.9
3	119.1	43.2	40.5	148.8	57.6	53.8
4	404.3	148.3	140.8	480.2	182.7	172.0
5	233.9	86.5	81.9	259.0	104.7	98.7
6	690.9	267.2	255.2	928.4	381.5	358.3
BASIN	3,250.3	1,256.3	1,196.4	4,241.9	1,711.3	1,614.1
		2000			2020	
Economic Subarea						
1	953.2	382.7	362.0	1,166.5	475.4	449.9
2	2,235.4	910.2	862.0	2,557.4	1,030.3	975.5
3	195.3	79.3	74.6	241.4	103.6	97.3
4	584.2	233.1	219.1	681.8	286.3	269.2
5	310.1	129.4	121.8	339.3	147.8	139.3
6	1,191.2	498.7	468.1	1,394.3	598.7	564.3
BASIN	5,469.4	2,233.4	2,107.7	6,380.7	2,642.1	2,495.5

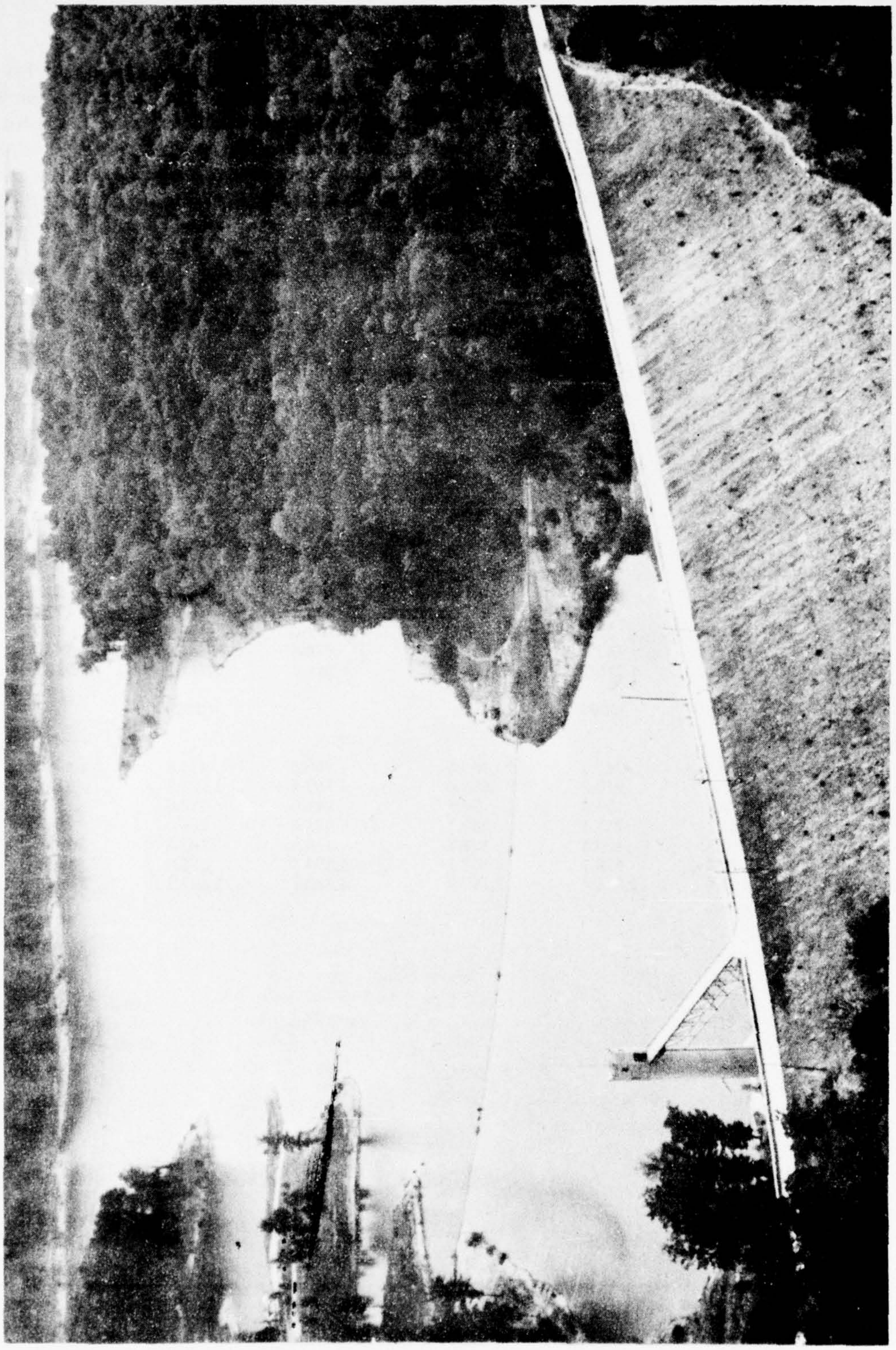


FIGURE 39. CAGLES MILL RESERVOIR, INDIANA – FIRST CORPS RESERVOIR IN THE WABASH BASIN

SECTION IV – STATUS OF WATER AND RELATED LAND RESOURCES AVAILABILITY, DEVELOPMENT, PROGRAMS AND PLANNING

INTRODUCTION

The ultimate objective of all river basin programs is to secure the best use or combination of uses for meeting foreseeable short- and long-term water and related land resource needs – the needs of mankind. An intrinsic part of this objective is the proper and balanced consideration of the economic, regional, environmental and social well being of all the people. As we have established previously, the development and use of water resources played a dominant role in the exploration and settlement of the Wabash River basin. Domination of the Wabash and its parent stream the Ohio River, which passed from the French to the English and then to the young United States, was essential for colonization of the region and a major factor in the early development of our Nation. Relocation and development of the abundant natural resources has made the region a workshop of world importance and a leader in molding much of the social, political and economic destiny of the Nation.

The basin contains an extensive system of Federal-State-local governmental and private water resource development projects. Many new programs and projects are being prosecuted vigorously in an attempt to keep pace with expanding needs.

An effective system of multiple-purpose reservoirs with flood control storage, operated in conjunction with local protection projects, provides protection to flood prone urban and rural areas. The reservoirs also have a storage potential for water supply, water quality control, hydroelectric power generation and environmental uses. The principal part of the storage capacity is in the Federal program, and the allocation of the total storage space by purpose and season, is presented in the following tabulation of table 19.

The mainstem of the river is one of the few historic trade routes of our early settlement era in the Nation, yet underdeveloped for modern navigation. The French maintained three settlements in Indiana to guard the Maumee-Wabash route connecting Lake Erie with the Ohio River. These settlements were a traders' gathering place, where they bartered with the Indians, maintained supplies and shipped furs to Montreal or New Orleans. At some future time waterway improvements may well provide for the transport demands of coal, oil, other minerals, grain and manufactured products from the heartland of the basin.

TABLE 19

FEDERAL RESERVOIR STORAGE IN THE 1968 PROGRAM

Purpose	Storage 1/ (1,000 Acre-feet) Winter	Summer
Flood Control	1,321.0	1,180.0
Low Flow Control	159.0	300.0
Water Supply	(–)	(–)
Water Quality	(159.9)	(300.0)
Sediment Control	106.1	106.1
GRAND TOTAL	1,586.1	1,586.1

1/ As of 30 June 1969.

Programs for land treatment and management, in combination with headwater flood-retarding structures, reduce flood damages and provide land conservation in many areas. Although these developments have been effective in serving the most critical needs of the basin, many problems remain. Drainage improvements have been made in agricultural land areas, especially in the northern and western portions of the basin. Irrigation is not extensively practiced at the present time; there are an estimated 13,800 acres now irrigated. Despite the many water and related land programs that affect the availability, quality and use of water, much is yet to be accomplished to satisfy the water needs of our day.

Public interest in development, preservation and in the totality of man's environment has greatly increased in recent years. The States in varying degrees have adopted new laws or amended old laws related to water resource management; have realigned state agencies for better coordination of water, land, health, recreation and economic administration; and have updated policies to be

better attuned to the present needs. The following paragraphs discuss in further detail the basin's water and land resource availability, the current state of development and the status of present planning.

LAND AVAILABILITY

Thus far we have described the land with respect to its physical characteristics and as an economic resource. Now the availability of land will be explained by discussing the relative competition for land use at the present time, in 1980 and 2020.

Estimated future land needs are based on projections of food, feed, and fiber output, and land requirements for non-agricultural purposes such as urban and commercial developments, recreation and reservoirs. Projections indicate that pressure will develop on the Basin's land base by 2000 in all subareas. Present and projected land requirements are shown in table 20. The 1980 projected requirements are shown assuming two different levels of resource development, with and without additional development. By 2000, the agricultural land in the basin is projected to be fully utilized. However, an increase in resource development would permit greater production of agricultural commodities from the same land base. Present and projected land requirements are shown in table 20.

TABLE 20
PRESENT AND PROJECTED LAND REQUIREMENTS
(Million Acres)

Land Use	1980 Without Additional Development	1980 With Additional Development	2000	2020
Cropland	13.14	13.07	13.27	12.97
Pasture	2.06	2.06	2.01	1.96
Idle	0.80	0.87	0.25	0.25
Forest	3.35	3.35	3.35	3.35
Urban	1.42	1.42	1.89	2.24
Other	1.24	1.24	1.24	1.24
TOTAL	22.01	22.01	22.01	22.01

The future national estimates of food, feed, and fiber output are based on the increase in population as set forth in the overall economic base study projections in combination with projected per capita consumption rates for the major commodities. Basically, the projections indicate that there is sufficient agricultural land in the basin to meet the estimated gross requirements to 2020, if additional resource development is implemented.

As population increases and urban areas expand, additional land is needed for homesites, service areas, industrial development, local recreational areas, highways and transportation facilities. In the period from 1968 to 1980, more than 215 thousand acres of crop and pasture land will be required for these urban related uses. Additional acreages required during the periods of 1980-2000 and 2000-2020 amount to nearly 470 thousand and 355 thousand acres respectively. By the year 2020, the amount of urban land is projected to be in excess of 2.2 million acres, or slightly more than 10 percent of the 22 million acres in the basin.

Coal demand in the Wabash River region is expected to increase substantially between 1968 and 2020, so coal stripping operations will continue. With development of larger equipment, remining of many areas will be possible. It is estimated that about 233 thousand acres will be affected by strip mining by 2020. Except for local effects on agriculture and the local economy, strip mining and other mining operations will not have a significant impact on the land availability of the overall basin.

SURFACE WATER

General

Surface water resources vary greatly in quantity, quality and location throughout the basin. Although basically dependent on climate, and ultimately on precipitation, the availability of surface water is affected by many natural factors and some that are man-made. About 50 percent of the streamflow occurs in the four months January through April. In the spring and summer, as vegetation renews itself, a significant increase in evapotranspiration occurs and streamflow begins to decline. Where groundwater seepage is deficient, particularly in headwater areas where the streams are shallow and do not intersect with sufficient groundwater sources, many small streams go dry during the summer and fall. Even in the larger tributaries, streamflow at times is insufficient to maintain adequate environmental stream quality.

Rainfall

In the study area, convectional systems, up-thrusting air masses moving southwest to northeast over the basin, and frontal activity are

the principal causes of precipitation. Variability is the most significant characteristic of the rainfall; this is illustrated in figures 40 and 41. The overall decrease in annual precipitation from south to north is illustrated by the lines of equal precipitation. During 1931 to 1960, average amounts of rainfall ranged annually from 44 inches in the southern part of the basin, to 36 inches in the north. In the southern counties, where rainfall is heaviest, precipitation is slightly more evenly distributed throughout the year. However, distinct months of maximum and minimum precipitation do occur. Throughout most of the area winter rainfall is light, about 50 percent of the rainfall occurs March through July.

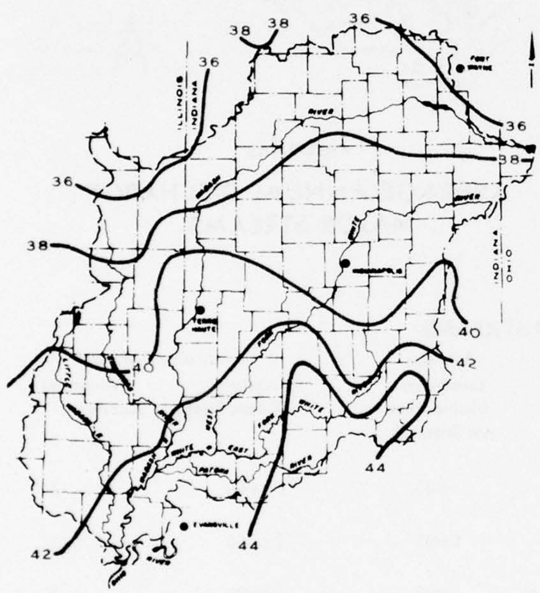


FIGURE 40

NORMAL ANNUAL PRECIPITATION (INCHES)

Storm rainfall is important for several reasons including the flood threat it poses and the opportunity it presents to store water for low flow periods. Storms of sufficient intensity and duration to produce flooding occur almost annually.

Runoff and Streamflow

Average annual runoff varies from about 10 inches in the northern basin to 18 inches in southern portions, figure 42. A distribution of stream runoff, as recorded by the stream gaging stations on the Mississinewa River at Marion, Indiana and East Fork White River at Shoals, Indiana, is 11.78 and 14.50 inches, respectively. As previously indicated the period of greatest runoff is January through April while the month of least flow is usually September to October.

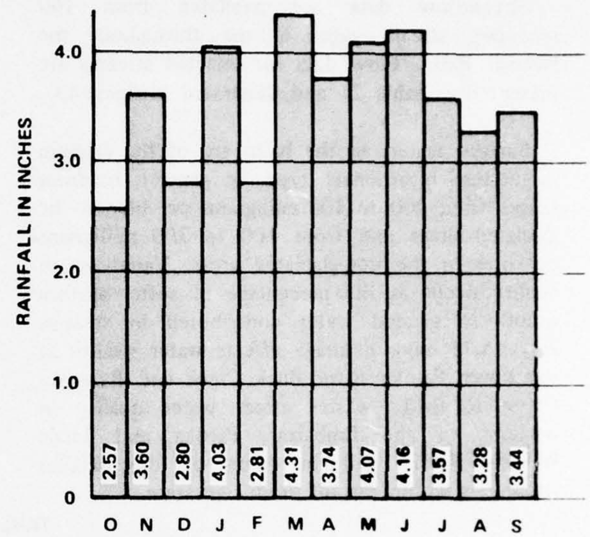


FIGURE 41

NORMAL MONTHLY RAINFALL AT SHOALS, INDIANA

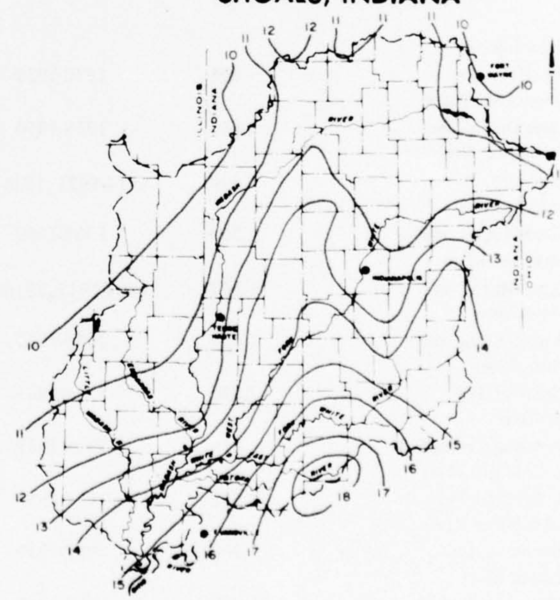


FIGURE 42

AVERAGE ANNUAL RUNOFF (INCHES)

Average rates of stream runoff range from 10 inches to almost 18 inches with the minimum values occurring in the southern portion of the basin. The average rate of flow along the main stem of the river is about 1.0 cubic feet per second per square mile.

Streamflow data are available from 160 recording stream gages in use throughout the Wabash Basin. Flow data for selected streams are presented in table 21 and illustrated in figure 43.

Surface waters in the basin are of the calcium magnesium bicarbonate type. In general, hardness ranges from 200 to 400 milligrams per liter in the glaciated areas and from 100 to 300 milligrams per liter in the non-glaciated areas. Variations in quality occur as the percentage of softer surface runoff to ground water contributed in streams vary. Acid mine drainage affects water quality in the lower Patoka River Buck Creek and Busseron Creek. Oil field wastes affect water quality in portions of the Embarras, Patoka and Little Wabash Rivers and in some of the smaller tributaries within the oil producing areas.

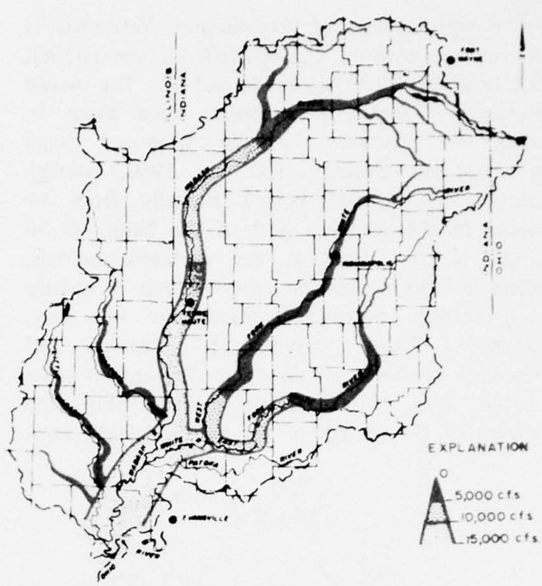


FIGURE 43

AVERAGE ANNUAL DISCHARGE MAJOR STREAMS

TABLE 21

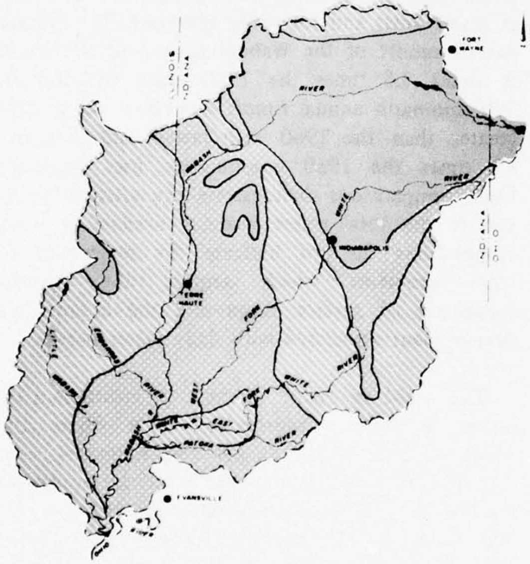
FLOW OF SELECTED STREAMS

Stream and Station	Drainage Area (Sq Mi)	Period of Record	Average Discharge (Cubic Feet per Second)	Extreme Discharge Maximum (Cubic Feet per Second)	Extreme Discharge Minimum (Cubic Feet per Second)
Wabash River Bluffton, Ind	506	1930-1959	403	11,800	3.9
Tippecanoe River near Delphi, Ind	1,857	1939-1950	1,601	22,600	1
Vermilion River Danville, Ill	1,280	1914-1921,1928-1959	897	48,700	2
Wabash River Terre Haute, Ind	12,200	1927-1959	10,440	189,000	690
Embarras River Ste. Marie, Ill	1,540	1909-1913,1914-1959	1,227	44,800	1
White River Indianapolis, Ind	1,627	1930-1959	1,411	37,200	6.8
White River Spencer, Ind	2,980	1925-1959	3,076	59,400	133
Eel River Bowling Green, Ind	844	1931-1959	854	34,000	11
E. Fk White River Columbus, Ind	1,692	1947-1959	1,981	48,700	87
E. Fk White River Seymour, Ind	2,300	1927-1959	2,431	78,500	84
Wabash River Mount Carmel, Ill	28,600	1927-1959	26,980	305,000	1,620
Little Wabash River Carmi, Ill	3,090	1939-1959	2,587	39,400	0.6

GROUND WATER

Supplies of ground water are available in most part of the Wabash River basin from two primary sources – glacial and bedrock aquifers. The sources and yield of ground water in bedrock and the unconsolidated materials throughout the basin are illustrated in figures 44 and 45. The groundwater aquifers have varying permeability, storage capacity and recharge rates. A classification and evaluation of the aquifers has been made by the U.S. Geological Survey according to their development potential and optimum development potential with proper management. The types of aquifers in the basin are ranked as follows when considering their development and management potentials: Valley-train deposits overlying and hydraulically connected to buried valley deposits, valley-train and outwash plain deposits, buried-valley sands and gravels confined by till or lake sediments, discontinuous sand and gravel lenses in the drift, Silurian and Devonian bedrock, Lower Mississippian bedrock, Upper Mississippian bedrock, Pennsylvanian bedrock, lake sediments, and glacial till.

More than 70 million acre-feet of water, 20 trillion gallons, are stored in the aquifers evaluated which include the valley train and buried valley aquifers and the Silurian, Devonian and Lower Mississippian bedrocks. These aquifers are generally capable of yielding more than 100 gallons per minute to individual wells. Total recharge to these aquifers averages more than 2 billion gallons per day.

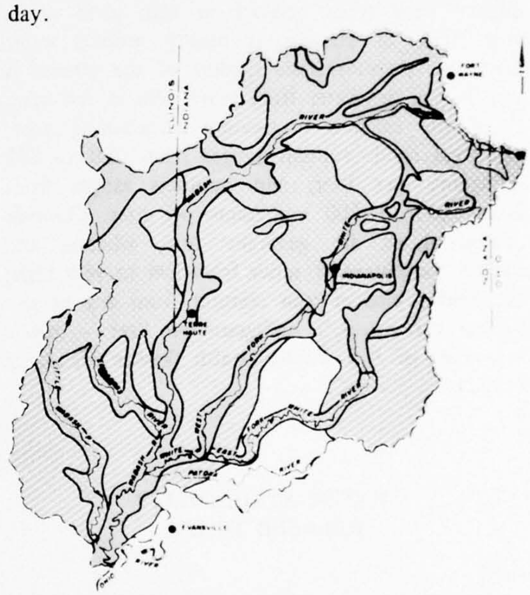


LEGEND

- Best aquifers: potential sources of supply for municipal or industrial use. Individual wells commonly yield 100 or more gpm.
- Sources of supply for small municipalities or industries. Individual wells commonly yield 20 to 100 gpm.
- Sources of supply for domestic use. Individual wells commonly yield less than 20 gpm.

FIGURE 44

SOURCES OF GROUND WATER IN BEDROCK FOUNDATIONS



LEGEND

- Best aquifers: potential sources of supply for municipal or industrial use. Individual wells commonly yield 100 or more gpm.
- Sources of supply for small municipalities or industries. Individual wells commonly yield 20 to 100 gpm.
- Sources of supply for domestic use. Individual wells commonly yield less than 20 gpm.
- Unglaciated area: unconsolidated rock aquifers not present.

FIGURE 45

SOURCES OF GROUND WATER IN UNCONSOLIDATED SEDIMENTS

Discontinuance sand and gravel lenses are locally important at various places in the basin, but their potential was not determined. The younger bedrock aquifers, the Upper Mississippian and Pennsylvanian bedrocks, as well as the lake sediments and till were not evaluated; these generally yield less than 20 gallons per minute to wells.

The chemical quality of the ground water cannot be put in specific terms for the entire basin. Quality of ground water, from shallow sand and gravel, shallow bedrock aquifers and surface streams at base flow, is quite similar. Sand and gravel water is generally of somewhat better quality than from bedrock in high yield areas. Base flow of streams is mostly ground water discharge, therefore, the quality of the stream is usuallv similar. Water from most wells in the basin is of the calcium magnesium bicarbonate type. Dissolved solids content ranges from 250 to 650 milligrams per liter, and hardness ranges from about 200 to 500 milligrams per liter. Chloride concentrations are generally low, whereas the sulfate concentration varies from low to very high; the lowest median iron content from any of the aquifer systems is 1 milligram per liter – this is in excess of U.S. Public Health Service Standards (1962).

WATER AVAILABILITY RELATED TO USE

Assessment of surface and ground water availability is of little significance unless the supplv and demand are related. Our water is used for many purposes – domestic and municipal, industrial and power, irrigation and livestock, navigation, recreation, fish and wildlife habitat, *and waste disposal – the water needs of our* human environment. The statisticians tell us that as a nation, some 2,500 gallons of water per day are required simply to maintain one adult human; this includes consumption and water to grow food. At the same time, our current use of water to produce goods, maintain air-conditioning and flush commodes exceeds 15,000 gallons per person per day. Fortunately, the bulk of these water uses are spread throughout the country. The 1970 municipal and industrial water use in the Wabash River basin, as projected from a survey made in 1962, is tabulated in table 22.

TABLE 22

1970 WATER USE

Hydrologic Subbasin	Ground Water (Million Gallons per Day)	Surface Water (Million Gallons per Day)	Total
Patoka	1.6	4.1	5.7
East Fork White	26.7	29.2	55.9
West Fork White	85.4	124.0	209.4
Upper Wabash	82.7	27.0	109.6
Middle Wabash	86.1	12.8	98.9
Embarras	5.2	7.8	13.0
Little Wabash	0.8	8.5	9.3
Lower Wabash	0.9	2.3	3.2
TOTAL	289.0	215.0	504.0

While the water resources of the basin are ample for present use, development is inadequate in many areas and for many purposes. The average annual runoff of the Wabash River near its mouth is about 4.5 times the 1960 basin withdrawals. The minimum annual runoff was about 40 percent greater than the 1960 withdrawals and is nearly 40 times the 1960 consumptive use. Although *these comparisions demonstrate the relationship of* use to the total water resource availability, such comparisons do not indicate the magnitude of local problems which require the storage, regulation of surface flows and the coordinated development associated with daily water needs.

The yield of many streams is insufficient to assure dependable sources of water where and when needed for municipal and industrial uses. This condition is more prevalent in the headwater reaches than on the principal tributaries or the main stem of the river. In development of the comprehensive plan, main stem reservoirs, headwater reservoirs and the development of ground water supplies were considered to solve the problems associated with stream variability in many of these locations. However, in several areas where large populations are located and in some small communities in the upland areas, the yield of impoundments, even with optimum storage is insufficient to satisfy early or future needs. Reliance on ground water and importation of water from adjacent basins has been proposed. Details of the relationships of available water supply sources to present and projected withdrawal and uses are provided in Appendix F – Water Use and Stream Quality.

IDENTIFIED POTENTIAL RESERVOIR STORAGE SITES

In considering all the water needs of the basin, the reservoir development potential of major reservoirs and upstream watersheds was inventoried. This inventory was incorporated into the initial reservoir screening phase of the comprehensive study. Considerations in compiling the site data included previous reports dealing with water resource developments in the basin and additional map and field studies made during the course of the investigation. A total of 174 major dam sites were identified having 41,000,000 acre-feet of storage capacity. The upstream watershed sites are in drainage areas of less than 250,000 acres and the total storage capacity of each site is less than 25,000 acre-feet. Over 1,400 upstream site locations were identified, and slightly more than 1,200 of these were found to have some degree of development capability. Identified sites in the upstream areas have a potential storage capacity of 6,000,000 acre-feet. Figure 46 indicates the subbasin distribution of the total identified storage potential of the basin.

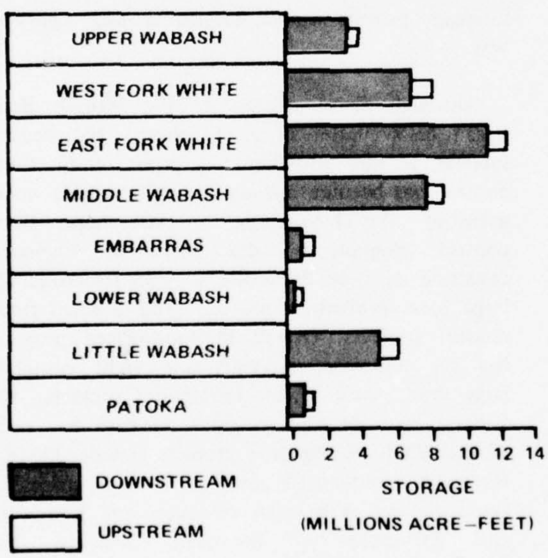


FIGURE 46

IDENTIFIED POTENTIAL STORAGE CAPACITY

The Upper Wabash subbasin which comprises about 1/4 of the total basin has the fewest available storage sites of all the subbasins due to its general lack of topographic relief. About 75 percent of all the sites studied have storage capabity for multiple-purpose use. The greatest concentration of potential sites are found in the East Fork White, West Fork White, Little Wabash, Patoka and Embarras Subbasins.

In addition to the main stem and headwater impoundment sites, there is a significant potential for development of farm ponds for rural water supply. Currently the average farm pond in the basin has a surface area of 0.75 acres and has 2.5 acre-feet of storage capacity; there are about 20,000 ponds. As of December 1968, there were about 20 non-Federal reservoirs with storage capacities varying from a few hundred to several thousand acre-feet. These are illustrated in figure 66.

FLOOD PROTECTION

Development Programs

There are an estimated 2,650,000 acres of flood plain land along the rivers and streams of the Wabash River basin – 13 percent of the total basin land area, 33 percent of the total flood plain lands in the Ohio River basin. Of this about 852,000 acres are in the flood plains of the upstream watersheds with the remaining 1,800,000 acres located along the main stem of the river and the major tributaries. About 76 percent of the flood plain is utilized for cropland and pasture. Forest lands occupy 17 percent of the flood plains; the remaining 7 percent is urban and improvements of public, commercial and industrial enterprises.

Many of the pioneer settlers of the area that would become the Wabash Region followed the natural water courses taken by early exploration parties from the Atlantic Coast, Great Lakes and the Gulf of Mexico to the interior. It was from this pioneer knowledge and experience that considerable work has been accomplished to relieve the costly and disastrous consequences of the basin's floods. Figure 47 is a mural in the George Rogers Clark Memorial at Vincennes, Indiana. The first effort of planned flood control in the Wabash River area, indeed the entire Ohio River region, dates back to 17 September 1807, when William Henry Harrison, Governor of Indiana Territory, approved an Act of the Legislature of the Indiana Territory for construction and maintenance of a levee downstream from Vincennes. The levee was

completed in 1808. Other early attempts to secure protection were made by individuals. As the need for more unified effort became apparent, adjacent landowners began to band together by mutual agreement. As a result, the need for power to issue bonds and to force recalcitrant owners into a project was taken to the State Legislatures for enactment of drainage and levee laws with necessary authority. Today, most of the existing levee organizations operate under the statutes of the respective political subdivisions with rights of taxation and eminent domain.

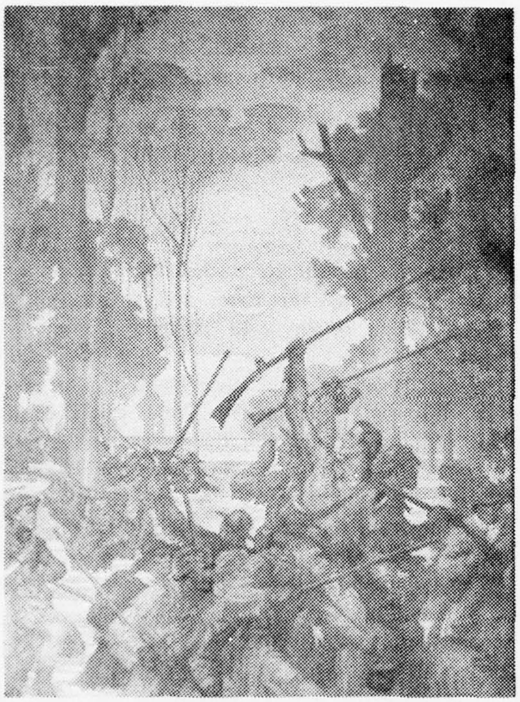


FIGURE 47. A PORTION OF THE GEORGE ROGERS CLARK MEMORIAL MURAL

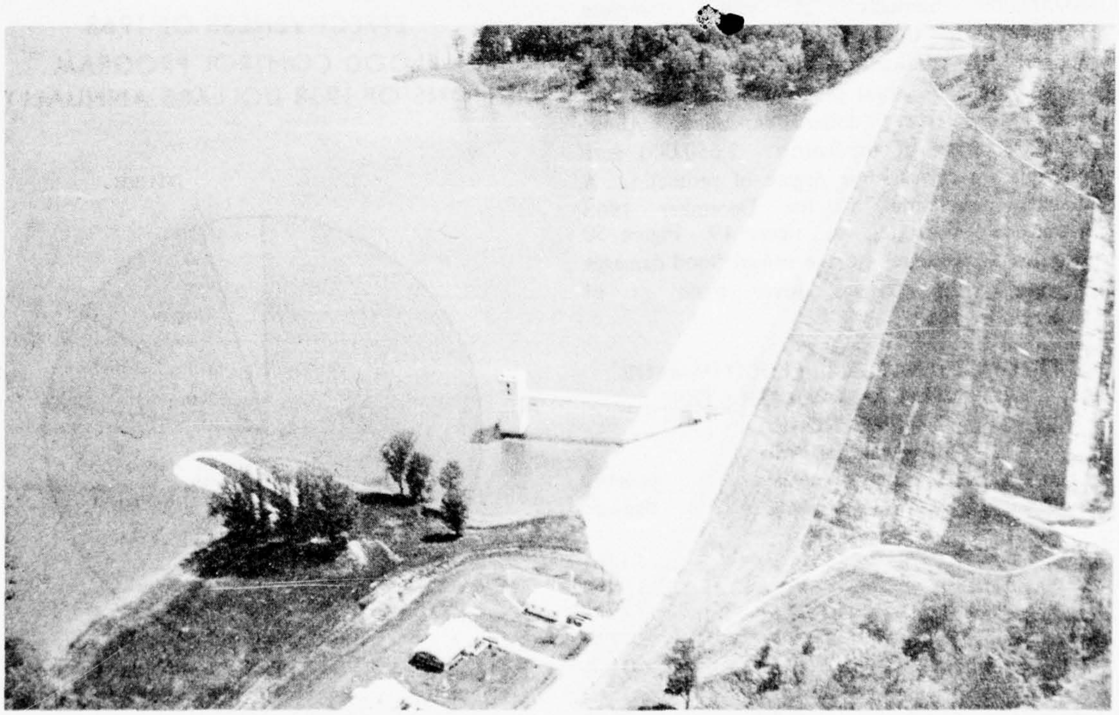
The battle to widen the responsibilities of the Federal Government to encompass flood control and other works in addition to navigation improvements revolved almost entirely around the nation's greatest flood problem: the propensity of the lower Mississippi River to overflow the vast and rich alluvial plain which it had created. From 1840 to 1936, the Congress was concerned in various degrees with the lower Mississippi River problem, but it was not until the disastrous floods of 1936 and 1937 that the Federal flood control program was initiated. The 1936, 1938 and later Flood Control Acts initiated a basin wide flood control program by authorizing a system of reservoirs and local protection projects. The plan, developed by the Corps of Engineers, has been modified many times as warranted by developmental needs.

Closely related to the foregoing legislation is the Watershed Protection and Flood Prevention Act of 1954, commonly referred to as Public Law 566. This act authorized the Secretary of Agriculture to assist local organizations to prepare and carry out plans for the reduction of flood damages along streams draining less than 250,000 acres. These plans may encompass both engineering works and land treatment measures. As originally enacted, Public Law 566 required local interests to provide lands, easements and rights-of-way and to assume such share of the cost of the flood control works as the Secretary of Agriculture should find appropriate. In 1956 the act was amended for the purpose of bringing the cost-sharing provisions into consonance with those of the flood control acts under which the entire cost of construction of Federal local flood control works are borne by the Federal Government, but under which non-Federal interests provide lands, easements and rights-of-way.

Although flood control in the Wabash Basin began as a matter of local concern, the Federal interest in the problem has grown until flood control has become one of the major public works activities. The 31 December 1968 basin flood control program of the Corps of Engineers consisted of over 85 projects – 25 reservoirs, 25 large local protection projects, and 8 small flood control projects. Overall the authorized program has six complete reservoirs and eight complete large and small local protection projects; the Federal cost of the program to date has been $200,000,000. Completed projects include 200,000 thousand acre-feet of reservoir storage space for flood control, 150 miles of levees and floodwalls and 25 miles of improved channels. The 31 December 1968 Corps program is illustrated by figure 64.

In the Small Watershed Program applications for assistance have been submitted on 89 upstream areas by the local people. These applications include a total land area of 10,580 square miles or 32 percent of the basin area. Forty of these applications have been authorized for planning and

TYPICAL UPSTREAM FLOODWATER RETARDING STRUCTURE



MANSFIELD RESERVOIR, CORPS OF ENGINEERS

FIGURE 48

seven applications were found to be not feasible. Work plans have been developed on 32 of these small watershed projects, construction has been authorized on 24 and construction has been completed on five projects. The 31 December 1968 Small Watershed Program is shown in figure 65. The authorized program includes 135 reservoirs which have a total storage capacity of 186,359 acre-feet. surface area of the permanent pools is 8,598 acres. Channel improvements, sufficient to secure a reasonable degree of protection and permit a high level of conservation management, are also included in the authorized program.

Flood damage estimates developed for this report by the Corps of Engineers and Soil Conservation Service included, as nearly as possible, an appraisal of all potential downstream and upstream damages, but only those upstream damages for which some reasonable basis for estimating was available. Flood damages in the Wabash River basin would have amounted to $25,000,000, December 1968 conditions, were it not for the progress of flood control and watershed programs. Table 23 illustrates that natural damages have been reduced by $10,000,000 annually. A more complete perspective of the present program can be obtained by considering that, to date, it is estimated that the total program has returned two dollars for every dollar expended. About 1,000,000 acres of the Basin's 2,650,000 acre flood plain receives some degree of protection. A summary tabulation of the December 1968 program is illustrated in figure 49. Figure 50 illustrates the residual average annual flood damages for the entire Wabash River basin as of 31 December 1968.

TABLE 23
ESTIMATED NATURAL FLOOD DAMAGE POTENTIAL AND MODIFICATION BY 1968 PROGRAM
(Thousands of Dollars)

Subbasin	Natural Damages	Modified Damages
Patoka	2,102.1	2,102.1
East Fork White	8,212.1	7,988.0
West Fork White	16,377.6	11,815.4
Upper Wabash	3,807.5	2,779.9
Middle Wabash	7,850.7	5,318.5
Embarras	2,781.2	2,781.2
Little Wabash	3,904.4	3,904.4
Lower Wabash	2,871.1	2,645.4
TOTAL	47,906.7	39,334.9

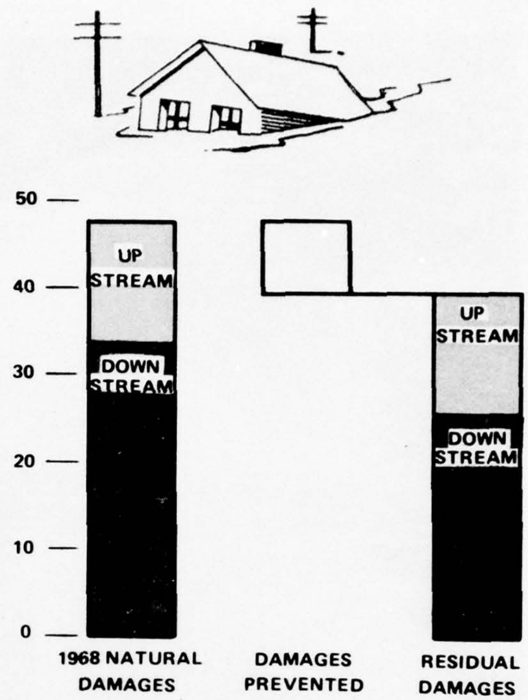


FIGURE 49

EFFECTIVENESS OF 1968 FLOOD CONTROL PROGRAM (MILLIONS OF 1968 DOLLARS ANNUALLY)

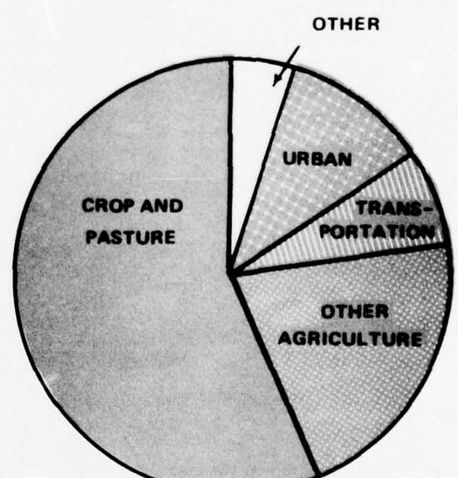


FIGURE 50

RESIDUAL FLOOD DAMAGE, 1968 ($39 MILLION ANNUALLY)

Other Measures

The Weather Bureau of the Environmental Science Services Administration operates a flood forecasting service for the Wabash River including several of the larger tributaries. This service provides advance notice by way of radio, television, newspapers and civil defense coordinators to permit evacuation of people, emergency protection of property and removal of damageable material from flood plains. A 5 to 10 percent reduction in the potential damages has been credited to such advance warnings, and an untold number of levees have been saved.

Where flood damages have been unbearably high, something is ultimately done. One of the age-old methods of accomplishing this is to abandon use of the flood plain. Such abandonment may be complete or partial as, for example, when cropland is permitted to revert to pasture or woods. In the Wabash Basin, particularly along the main stem and the more flood prone tributaries, abandonment has been a typical solution. It is not uncommon along the major basin stream to encounter an abandoned or untended field. A part of this problem is, of course, due to the exodus of the rural population to centers of stable employment, but a part of the problem has been the frequency and inconvenience of annual floods. Abandonment of larger flood plains and urban flood plains is not generally feasible. The cost to the region and the nation of the necessary adjustments would be very high, and the existing production is so great that it can not be absorbed by the existing surplus capacity – perhaps future technology will make abandonment more feasible. It should be recalled here that 13 percent of basin is in flood plain.

A measure which is receiving progressively greater attention, as the basin's flood plains are more intensively developed, is regulation of flood plain use. This requires the use of the legislative and police powers of the states, and then subdivisions, to so control the development of flood plains that excessive damage will not be suffered when great floods occur. Legislatures of the basin states have generally bestowed on state agencies comprehensive authority for regulating construction and encroachments in flood plains and floodways of streams with a view toward protecting lives and property and preserving the capacity and efficiency of floodways. Generally, all of the basin states have statutes which provide for some control over construction in, over and along streams. The cities, counties, townships and boroughs have authority granted them by legislative enactment over land use. Provisions in local zoning ordinances to regulate flood plain use are relatively a recent innovation. The number of communities with adequate regulations is still quite low.

The slowness with which the regulation of flood plain uses is being undertaken is due to (a) reluctance of the public to accept regulations limiting individual freedom of action, (b) reluctance of local officials to resist pressures from special interest groups, (c) lack of information regarding flood hazards, (d) lack of guidance for planners in planning wise use of flood plains, and (e) lack of adequate authority for flood plain regulation in planning laws.

Federal flood plain information studies have been successful in informing the public on problem areas and helpful in providing the impetus for initiating the necessary action to regulated flood plain development. The studies provide basic data concerning flood potentials and conditions to states, local governments, agencies and citizens. The data are of great value in the establishment of land use regulations. As of September 1967, there were 43 areas within the basin for which flood plain information studies had been authorized. Eleven were completed.

In 1970 a broader and more unified program for managing flood losses was implemented by a Presidential Executive Order which directed all Federal agencies to evaluate flood hazards when planning for new facilities and in connection with (a) the administration of Federal financial aid for facilities construction, (b) the disposal of Federal lands or properties so as to attach appropriate restrictions to their future use, and (c) programs which entail land use planning.

Flood insurance has been advocated for many years, but has not been available to the general public because the nature of flood risks is quite different from that of other insurable risks, and the data necessary for establishing reasonable insurance rates has been lacking. The objective of flood insurance is to help provide financial assistance for victims of flood disasters in order to

rehabilitate their property, as well as to help prevent unwise use of land where flood damages would mount steadily and rapidly.

A flood insurance program, as a matter of national policy for sharing the risk of flood losses, was established under the National Flood Insurance Act of 1968 (Title XIII, House and Urban Development Act of 1968, Public Law 90-448) and became operative on 28 January 1969. The program will be administered by the Federal Insurance Administration, an agency of the Department of Housing and Urban Development. Under this program, which is designed to make flood insurance available through a cooperative effort between the Federal Government and the private property insurance industry, coverage will be available initially for one to four family residential properties and at a later date for small business properties.

Flood insurance under the program may be made available only in states or areas which have evidenced a positive intent in securing flood insurance and which gave assurances that by 30 June 1970, appropriate land use control measures would be adopted. After 30 June 1970, no new flood insurance coverage was to be provided in any area which had not adopted such measures. The purpose of the assurances is to encourage the adoption of permanent state and local measures which, to the maximum extent feasible, will: (a) constrict, where appropriate, the development of land which is exposed to flood damages; (b) guide the development of proposed construction away from locations which are threatened by flood hazards; (c) assist in reducing damage caused by floods; and (d) otherwise improve the long-range land management and use of flood prone areas.

MUNICIPAL, INDUSTRIAL AND RURAL WATER USE

Introduction

Whatever its source – rivers, lakes, springs, or wells – water has been and remains a critical resource contributing to the developmental and environmental resources of the Wabash Region. Since the settlement era of the basin and perhaps to the era of ancient men in the Pleistocene epoch, water has required development to secure life itself and to make possible development of other resources. This critical substance has been developed to satisfy constantly increasing demands for water supplies for human, industrial and agricultural uses.

The growth of the basin economy requires increasing supplies of water to maintain its growth. Rising levels of the economy on one hand and growing water requirements on the other are mutually dependent. The early water supplies were obtained from dependable flows of perennial streams, springs and shallow wells. As the population increased and the economy required additional supplies, these demands were met by the development of additional or expanded sources. Growth has been essentially continuous since the late 17th century, but the most significant growth has occurred in this century since 1940. In 1960, there were 381 central water supply systems, while only 51 or about 15 percent of these systems utilized surface sources of supply, they provide 64 percent of the 342 million gallons of water per day supplied from central sources. The 7 largest systems, serving Indianapolis, Muncie, Anderson, Terre Haute, Danville, Kokomo, and Champaign-Urbana, serve 49 percent of the population supplied from central water distribution systems. A summary of water supply usage is illustrated in figure 51.

As of 31 December 1968, six major Federal reservoirs and five upstream watershed projects had been constructed; these include 163,000 acre-feet for water supply storage space. In addition, about twenty major non-Federal reservoirs had water supply storage capacities varying from several hundred acre-feet to several thousand acre-feet. These latter developments provide only a small fraction of the water needs in the basin.

The available resources and going programs for water supply are adequate in most areas to meet current and immediate future demands due to the abundance of water resources throughout most of the basin. However, the related withdrawal and use facilities such as domestic water treatment plants and distribution systems will need to be improved to keep pace with the increased demand. While supply may now be adequate for withdrawals from a given stream location, the return flows available for reuse in the future will be diminished by consumptive use losses and

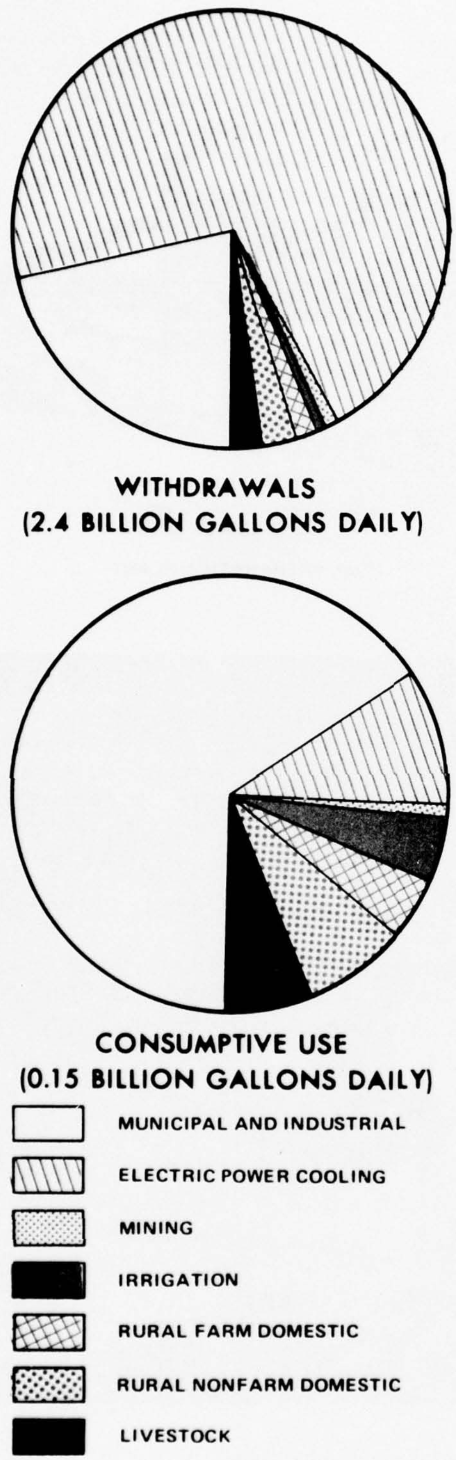


FIGURE 51
1968 AVERAGE WATER SUPPLY USE

replacement from storage will be required to serve downstream needs.

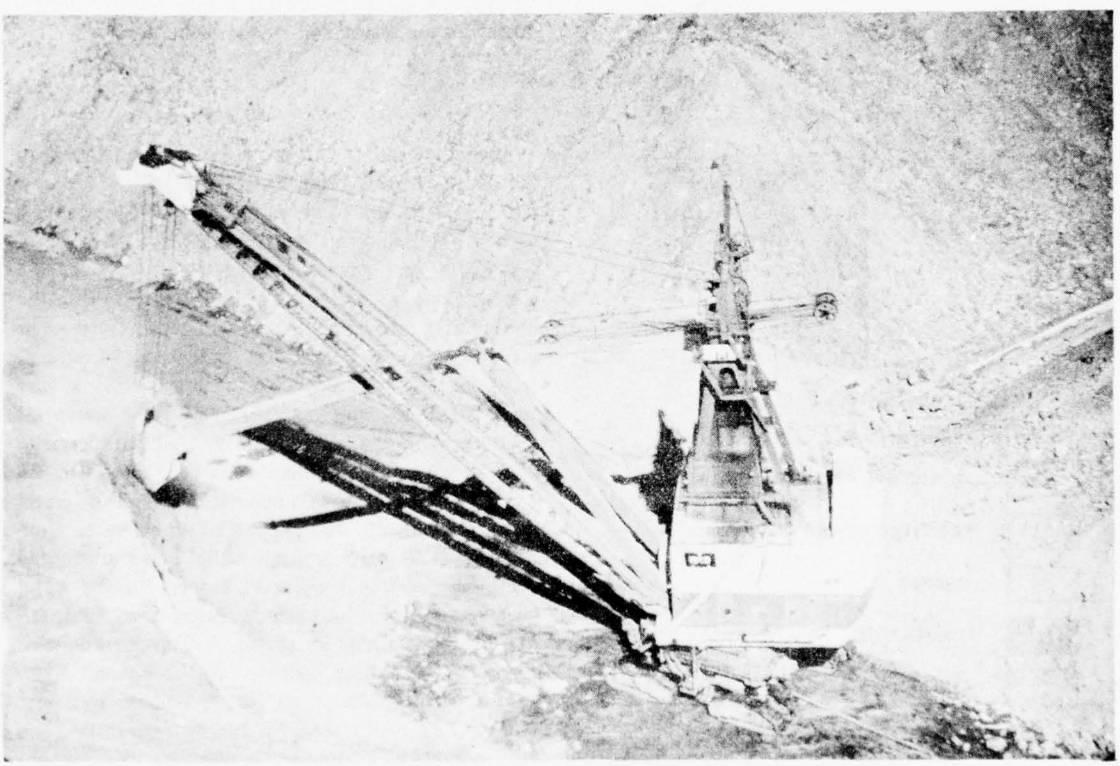
Industrial

The manufacturing sector of the Wabash Basin comprises a corps of industry whose output, measured by "value added in manufacture", exceeded 4,148 million dollars in 1963. In the huge and changing product mix of the Basin's industry, attempts to relate water use to physical output by units of production would be difficult as individual establishment data are not available. However, water use estimates indicate that the industrial production processes use about 50 percent of all water withdrawn for municipal and industrial purposes. The major water using activities include: agriculture, mineral production, manufacturing and construction. The availability of water of sufficient quantity and quality is one of the major factors that will be required to permit the expansion of industrial activity. A failure to provide it may result in serious losses for the region and indeed the nation.

Estimated water intake by mineral producers in the basin during 1960 was 7,478 million gallons, table 24. Of this total, sand and gravel operations used 4,171 million gallons, or 55 percent. The coal and sand and gravel industries recirculated the greatest amount of water. Of that water used in the mining and processing of crude minerals, 34 percent came from mines, 31 percent from wells, 24 percent from lakes, 11 percent from streams, and a very small amount purchased. Lakes were the source of 85 percent of the water used by coal producers. In crushed stone operations, wells accounted for 58 percent, and lakes 20 percent. Sand and gravel operators derived 42 percent of their water from rivers and 30 percent from wells. Lakes accounted for 56 percent and wells 33 percent of the water used in dimension stone operations. In the petroleum industry water for drilling requirements totaled 101 million gallons. An estimated 9,389 million gallons were used in secondary recovery. Potable water was used in drilling operations, and both potable and saline water was used in secondary recovery. About 91 percent of the water used by the petroleum industry came from wells and nine percent from lakes.

OIL WELL WATER FLOODING OPERATION

COAL PREPARATION PLANT



MINING AND THE PREPARATION OF MINERAL PRODUCTS
ARE TWO OF THE LARGER INDUSTRIAL WATER USERS IN THE BASIN

FIGURE 52

TABLE 24

ESTIMATED WATER USE
MINERAL INDUSTRY – 1960
(Millions of Gallons)

Commodity	Intake	Discharged	Recirculated	Consumed
Coal	1,072	978	9,538	94
Crushed Stone	1,545	1,475	242	70
Dimension Stone	589	574	44	15
Sand and Gravel	4,171	4,054	7,870	117
Petroleum	101	–	–	101
TOTAL	7,478	7,081	17,694	397

Municipal

The most fundamental requirement placed on the water resource of the basin is the provision of supplies of water for domestic and municipal use. These supplies are from ground or surface sources, treated as necessary for quality, and supplied for use. In 1960, total municipal water use was about 370 million gallons per day or about 114 gallons per capita per day. Of this total about 90 million gallons per day was ground water and 150 million gallons per day was surface water. Safe yield for some larger municipalities in 1960 are shown in table 25. Indianapolis and the suburbs served from its central system used 75 million gallons per day in 1963 or 31 percent of the basin total.

Rural

Water use for the rural community, domestic, rural non-farm domestic, and livestock is estimated to be 171 million gallons per day. Rural water use in the basin has grown steadily; this growth is related to a wide variety of factors including changes in population, technology, and socio-economic conditions. Daily per capita domestic water use is 88 gallons. In addition to farm home supplies, there are an indeterminate number of wells and 19,500 ponds, but other water sources include springs, creeks, rivers, and lakes.

Agricultural uses of water, other than domestic, consist of livestock and poultry watering, spraying and cleaning, but it excludes use for supplemental irrigation. The water requirement in the livestock category ranges from about 0.6 gallons per day for poultry to 25 gallons per day for cattle. At the present, the total livestock water use in the basin is about 50 million gallons per day.

TABLE 25

BASIN WATER SUPPLIES
FOR SOME LARGER MUNICIPALITIES

Municipality	Population (1,000)	Source 1/	Yield (MGD)
Jasper, Indiana	7.9	SW	3.0
Princeton, Indiana	7.9	GW	2.0
Bloomington, Indiana	31.4	SW	24.0
Columbus, Indiana	20.8	GW	6.3
Anderson, Indiana	49.1	GW	16.3
		SW	18.1
Indianapolis, Indiana	476.3	GW	40.0
		SW	120.0
Muncie, Indiana	68.6	GW	5.0
		SW	13.8
Kokomo, Indiana	47.2	GW	4.5
		SW	8.0
Lafayette, Indiana	42.3	GW	43.5
Marion, Indiana	37.9	GW	22.5
Champaign, Indiana	49.6	GW	23.0
Terre Haute, Indiana	72.5	GW	30.8
Mattoon, Illinois	19.1	SW	4.35
Charleston, Illinois	10.5	SW	0.65
Effingham, Illinois	8.2	SW	6.3
Olney, Illinois	8.8	SW	3.6
Mt. Carmel, Illinois	8.6	SW	10.0

1/ GW - Ground Water; SW - Surface Water.

Programs

Federal, state, local communities, and private interests have contributed to the existing development of the basin's water supply resources. The extent to which each governmental agency or unit has participated has varied greatly, the state agencies and some of the Federal agencies generally confining their activities to collecting basic data, furnishing technical assistance,

FIGURE 53. A TYPICAL RECREATION DEVELOPMENT AT A CORPS PROJECT

regulating the activity of others and issuing permits. Within the basin area most Federal construction has been performed by two agencies: the Corps of Engineers and Soil Conservation Service. Some development has been accomplished by local agencies and private interests. Local governmental agencies have been active in the development of both ground and surface waters, and private interests chiefly of ground water supplies. Several surface water reservoirs, however, have been completed by private corporations for both domestic and industrial purposes. To discuss the role of all of the Federal and state agencies involved in the Wabash Basin's water supply activities would entail a rather lengthy report in itself, and to some degree this reporting is accomplished in Appendix M, State Reports. For the purposes here, a summary of the agency programs is tabulated in table 26.

TABLE 26

AGENCY ACTIVITIES IN WATER PLANNING AND DEVELOPMENT

Agency	Basic Data	Studies and Research	Finance, Operation, or Construction	Regulation
FEDERAL				
Corps of Engineers	X	X	X	X
Department of Agriculture,				
Farmers Home Administration			X	
Soil Conservation Service	X	X	X	
Department of Commerce				
Economic Development Administration			X	
Department of Health, Education and Welfare				
U.S. Public Health Service				X
Department of Interior				
U.S. Geological Survey	X	X		
Environmental Protection Agency				
Federal Water Quality Administration	X	X		X
Federal Power Commission	X	X		X
NON-FEDERAL				
Illinois				
Commerce Commission				X
Department of Public Health				X
Department of Registration and Education	X	X		
Department of Public Works and Buildings	X	X	X	X
Department of Mines and Minerals				X
Indiana				
Department of Commerce			X	
Department of Natural Resources	X	X	X	X
State Board of Health	X	X		X
Public Service Commission				X
Ohio				
Department of Development		X	X	
Department of Health				X
Department of Natural Resources	X	X	X	X
Department of Public Works			X	
Ohio Water Development Authority			X	
Public Utilities Commission				X

ELECTRICAL POWER

The electric power industry in the Wabash Basin is composed of 97 utility systems located either partially or totally within the Power Region: 7 investor-owned, 31 cooperative, and 59 municipal. Generating capacity of the investor-owned utilities is about 95 percent of the total. The remaining 5 percent is maintained by municipal ownership. All three ownership categories have system requirements exceeding their actual energy generated. Steam-electric plants, using coal or natural gas as fuel generate the major portion of electric energy produced in the Power Region. As of 1970, there were 27 steam-electric plants ranging in size from 5,750 to 962,000 kilowatts of capacity; 15 internal combustion and gas turbine plants which range from 850 to 104,500 kilowatts of capacity; and 3 hydroelectric plants which range from 384 to 11,000 kilowatts of capacity.

Hydroelectric power is not an important energy source in the basin, as the general topography is unfavorable for large developments; the three operating plants represent less than 1 percent of the Region's installed capacity. In 1970, the 27 steam-electric generating plants had a total capacity of 4.8 million kilowatts, and cooling water for steam condensation was required. Various systems of cooling are utilized, some having a higher consumptive use of water than others. Table 27 summarizes the water requirements and consumptive use for the basin.

TABLE 27

REQUIREMENTS AND CONSUMPTIVE USE FOR WABASH POWER REGION – 1965

Use	Quantity (Acre-feet/Year)
Cooling Water Requirements	1,876,500
Diversion	1,103,200
Consumptive Use	17,900

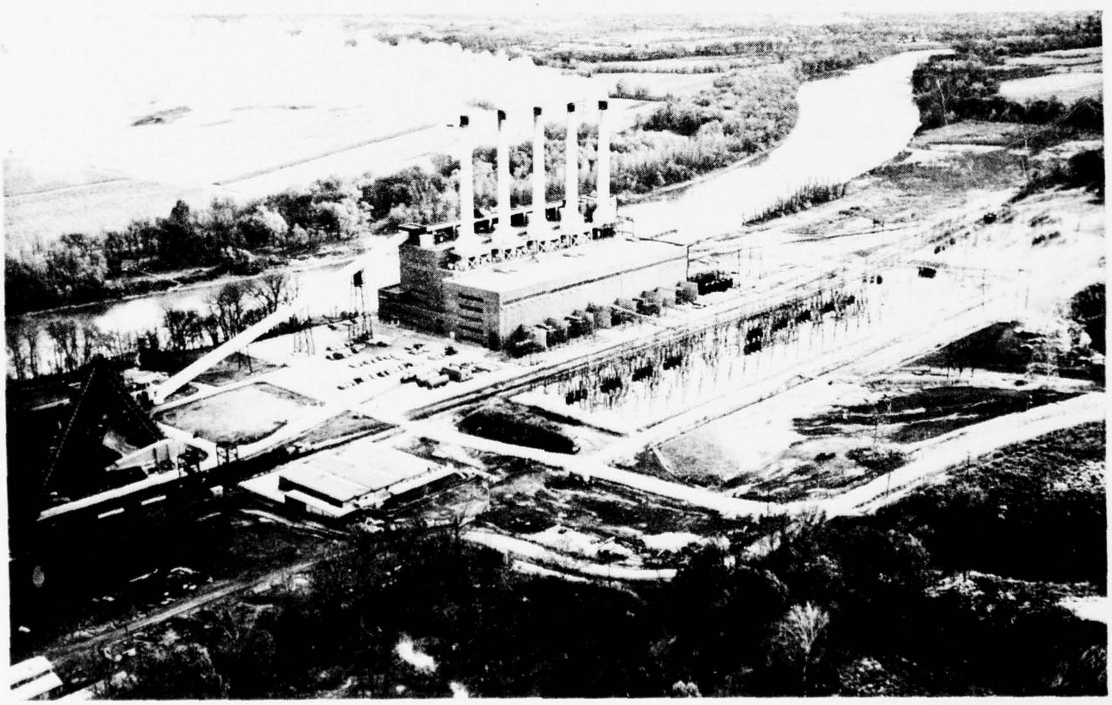


FIGURE 54. THE WABASH RIVER GENERATING STATION, NORTHWEST OF TERRE HAUTE, INDIANA

WATER QUALITY CONTROL

Today's concern about water and its quality is not surprising, as this very important substance of life has dictated the fate of tribes, nations, cities, settlements and civilizations since the dawn of mankind. Aesthetically delightful waters add to the quality of human experience; our literature, art and photography dwell upon waterfalls, streams, waves and lakes as quiescent scenes of special value in our environment. The occurrence of pollution and the fear of its consequences reduces aesthetic values; the knowledge that water is unclean affects its human use and appreciation. Each use of water adds some material or changes some characteristic enough to alter the original quality of the water.

Wastewater from residential and commercial buildings in incorporated areas in the Wabash Basin is generally handled by municipal sewerage systems unless the area is not yet sewered and privately operated sewage disposal systems, primarily septic tank systems, are in use. Exceptions are the investor-owned or privately owned sewerage companies, usually in developing areas of the large communities.

Of the roughly 260 incorporated communities with recognized sewer systems, approximately 97 percent are operated by the governing bodies of the cities or towns which they serve. Six sewerage systems are operated by special districts, and two communities contract with adjoining municipalities for waste treatment. Industrial wastes constitute the other major type of pollution originating as a point source of pollution.

In the basin as a whole, organic waste loads from municipal and industrial waste sources are approximately equal. The metropolitan Indianapolis area and the surrounding counties account for about one-fifth of the domestic and commercial and almost one-third of the industrial organic load of the entire Wabash Basin. In all of the subbasins, except the West Fork at Indianapolis, the Middle Wabash at Terre Haute and the Upper Wabash in and downstream from Wabash County, the industrial organic waste loading is in the general range of 50 to 75 percent of the domestic and commercial loading. The 1968 municipal waste load for the basin is shown in figure 55.

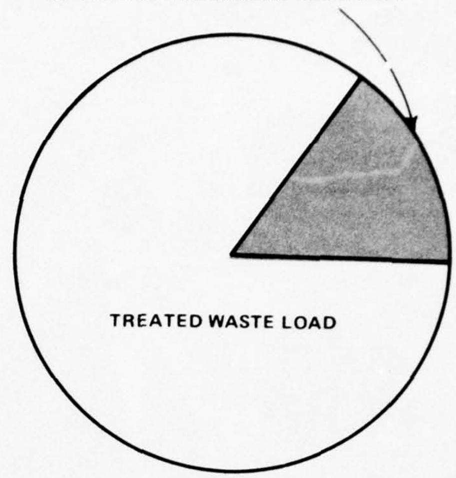


FIGURE 55

1968 MUNICIPAL WASTE LOAD (3 MILLION POPULATION EQUIVALENTS)

During critical low flow periods, release of reservoir stored water to supplement seasonal flows aids materially in improving water quality. By 1968, none of the Federal reservoirs constructed were functionally providing storage for low flow augmentation. The overall going program in 1968, in addition to the foregoing projects, includes an authorized construction program of four additional mainstem reservoirs with 44,300 acre-feet and two upstream watershed projects with 2,518 acre-feet for water quality purposes.

AGRICULTURAL, CONSERVATION AND MANAGEMENT

Watershed treatment and management programs in the basin are fundamental for the protection and enhancement of our total living environment – the water, soil, vegetation and wildlife – these programs are the assurance that the optimum combination of water quantity and water quality are secured. It is indeed fortunate that present programs improve the quality of the basin's waters while ameliorating the quality of the land. Of course, some conflicts are inevitable within the growing competitive perspective for resources and the multi-purpose nature of the total program.

FIGURE 56. AN EXAMPLE OF VARIED LAND USE, WELL DISTRIBUTED AMONG CROPLAND, PASTURE AND FOREST.

The present state of the basin's programs include developments from small one-quarter acre ponds to huge lakes, several hundred acres in size; field drains to large channel improvements; and small recreation developments to large public recreational forest parks. Generally, the resource developments have lagged demands – recreation, flood control and environmental preservation and enhancement – these are some of the programs that have lagged a growing immobile population.

Soil and Water Conservation Districts, political subdivisions of the states, have been organized in 102 of the 103 basin counties, these include 99 percent of the land and water of the study area. Programs of the districts involve farm and ranch planning with soil and water conservation practices to reduce erosion and sediment damage. Conservation practices resulting from this program have involved the construction of 18,300 farm ponds, the proper stewardship of 66,700 acres of wildlife habitat and the forestation of 87,200 acres. All of these program elements and those of the total program, are part of an environmental approach to conservation with a multiple-use objective. Hopefully, all of these and future measures will tend to develop a popular sense of pride and husbandry for the land.

Since 1935, farm families, rural property owners, and communities in the basin have been assisted in the development of water resources, land resources and related projects by the loan program of the Farmers Home Administration. Soil and Water loans have been provided farmers for land and water developments, basic conservation measures and forest enterprises. Community Service loans and grants have been provided 106 legal entities in the basin for the development, distribution and control of water; installation or improvement of waste disposal or drainage facilities; construction of outdoor recreation improvements and conservation practices and/or shifts in land use. Eighteen Comprehensive Planning Grants have been made to assist in preparation of comprehensive county-wide plans for development of water and sanitary systems.

The U.S. Forest Service has Federal responsibility in forestry and natural resource management. Portions of the Hoosier National

Forest, containing 83,000 acres of land and 1,184 surface acres of water, are located in the basin. Programs of this agency encompass the management of the Hoosier National Forest, forestry leadership and forest research.

Forty rural electric cooperatives distributed power during 1968 to approximately 210,000 rural consumers in the basin. The Southern Illinois Power Cooperative and the Hoosier Energy Division furnish wholesale power supply to electric distribution cooperatives serving the area. Although not directly related to water and land resources development, the availability of electric power for water developments and modern farm living.

Several resource planning and development programs are administered by the Soil Conservation Service; these include the Resource Conservation and Development Program; Small Watershed Projects under Public Law 566, 83rd Congress; and technical assistance to landowners under Public Law 46; 74th Congress. Resource Conservation and Development Projects are initiated in areas where the acceleration of current conservation activities will fulfill urgent needs and provide additional opportunities for local people. Three projects, wholly or partially in the basin, include the Lincoln Halls, Shawnee Hill, and Skillet Fork projects. Project development, within the authority of Public Law 566, is provided for watersheds up to 250,000 acres after a local application is approved by the Governor of a state. The status of the small watershed program is illustrated in figure 65. Applications have been submitted on 89 upstream areas, and these applications include a total land area of 10,580 square miles or 32 percent of the basin. Included in those projects currently authorized for construction, there is a total storage capacity of 186,400 acre-feet – 17,900 acre-feet of sediment, 101,300 acre-feet for flood protection, 8,600 acre-feet for municipal and industrial water supply, 2,500 acre-feet for water quality control, 312 acre-feet for irrigation, 53,900 acre-feet for recreation and 1,800 acre-feet for fish and wildlife.

Assistance programs under the authority of Public Law 46 include preparation of farm conservation plans including planning for water and land purposes with the ultimate goal of erosion reduction, sediment production and maintenance of the environmental resources of the basin. About half of the study area's 22,000,000 acres have been soil mapped under this program. Table 28 summarizes agency involvement in the various areas of water resource interest.

ENVIRONMENTAL RESOURCES

General

The term environmental resources as used in this report includes those water, land and development features relating to outdoor recreation, fish and wildlife conservation, general project beautification, history, scenery, archeology or ecology, whether or not they are now so used or identified. Environmental resources are many things to many people in the Wabash valley – the still waters of Cypress Slough in Posey County, Indiana, the essence of history in the Old French Cemetery at Vincennes, the architecture of Indianapolis or the quiet waters of the Wabash – through history, writings, and poetry have been inspired by less dramatic subjects.

TABLE 28

**AGRICULTURAL AGENCY ACTIVITIES
WATER RESOURCES**

Agency	Conservation Programs	Studies and Research	Finance	Construction
Agricultural Stabilization and Conservation Service	X		X	
Farmers Ho..e Administration			X	
Forest Service	X	X	X	X
Rural Electrification Administration			X	
Soil Conservation Service	X	X		X

FIGURE 57. SAIL BOATING AT MANSFIELD RESERVOIR

In the efforts of the next few paragraphs the emphasis is directed to the developed resource features whereas in Section II, the characteristics, historical, archeological, and scientific areas were treated.

The increasing concern of all Americans about our environment has taken new dimension in response to the realization of the total environmental perspective within the framework of these major factors:

- **Increasing total population**
- **Increasing urban concentration**
- **Increasing per capita real income**
- **Increasing per capita leisure**
- ***Increasing personal mobility and* activity patterns**
- **Increasing knowledge and awareness of knowledge voids about man and environment**
- **Increasing value-attitudes about history, nature, etc.**

It is these same factors which are responsible for the steady and rapid rise in demand for the recreational segment of environmental resources.

Recreation

An inventory of existing recreation facilities in the Wabash River basin was developed primarily from the Bureau of Outdoor Recreation's planning efforts, and included areas which were in operation in 1968. The rapid growth of demand for outdoor recreation, especially that which is water oriented, is vividly illustrated by the use pressure on Corps of Engineers Wabash reservoir projects for recreation activity. Use pressure at the Corps projects is great – a total of over 1,800,000 visits in 1968 – but pressure on the total basin recreation resource is uneven in several respects. Of a total basin demand of 13,707,000 man-days use in 1968, about 48 percent occurred in Federal recreation areas; 37 percent at state-owned facilities and the *balance at locally administered areas. Attendance* data showed that although the greater recreation acreage was owned by state agencies, Federal developments attracted more total visitors per acre; 200 visitors per acre as compared to 18 visitors per acre at state developments; local areas showed a usage of about 350 people per acre. Visitation at all facilities is concentrated during the summer and furthermore on weekends. One and one-half times as many people come on an average weekend day as on an average weekday.

As the basin population continues to expand and other influencing factors become more paramount, it is reasonable to expect that ever increasing requirements will be placed on existing and proposed recreational facilities. The provision of new and expanded recreational opportunities will permit substantial portions of the area's people to realize the full meaning of increasing leisure time and gains in personal income. From the visitation statistics, it is evident that water resources are a primary focal point of outdoor recreation. Swimming is the most popular of the basin's recreation activities, and it is likely to retain a high position. Boating and water skiing are fast growing in popularity. Eight outdoor activities including camping, picnicking, hiking, sightseeing and nature walks are also popular recreational activities.

Nationally as well as in the basin, recreation acres are located where the people are not. Eighty percent of the Basin's recreation areas are located where only 20 percent of the people live. Summarization of inventoried facilities indicates that the basin offered over 587,500 thousand acres of recreation lands and waters in 1968. Federal developments accounted for approximately 40 percent of the land acreage, state areas 55 percent and local areas about five percent of the total recreation. Surface area of water made up in excess of 181,000 acres or about 31 percent of the Basin's 1960 recreational area. About twelve percent of this water was provided on Federal areas while seven percent was on state lands and the remaining percent in major local developments. The Basin's present recreation supply is illustrated in figure 58.

These comparisons of administrative units do not represent a true commercial picture of total land ownership characteristics since not all state and locally administered lands were included in the inventory. However, most of the water areas were inventoried, and the figures do show that Federal development of water resources constituted by far the major source of impounded water for recreational activities. The passage of Public Law 89-72, the Federal Water Project Recreation Act, may result in an even greater participation by state and local agencies in recreational development and administration at Federal water projects.

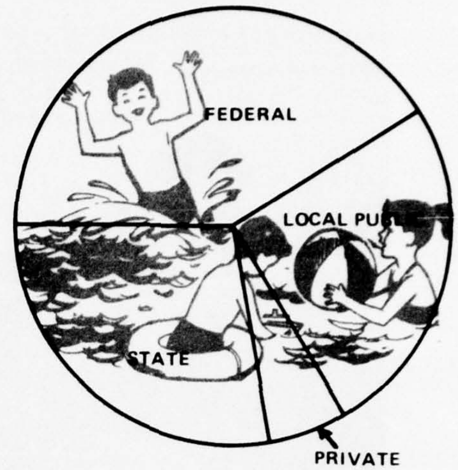


FIGURE 58

PRESENT RECREATION SUPPLY (16 MILLION ANNUAL RECREATION DAYS)

Sport Fishing

Fishery resources in addition to serving as a basis for a major element of outdoor recreation in the basin are important as a source of nutritionally valuable food. The same economic and social factors, that have created a growing demand for outdoor recreation, have increased enthusiasm for sport fishing and hunting.

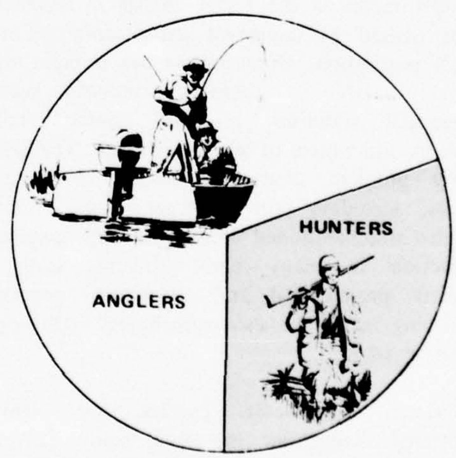


FIGURE 59

SPORT FISHING AND HUNTING

FIGURE 60. IMPROVEMENT OF WILDLIFE HABITAT CONDITIONS IS NEEDED TO MEET THE GROWING DEMAND FOR OUTDOOR RECREATION

Fishing over the years has been one of the Basin's popular forms of outdoor recreation. However, fishing licenses actually decreased from 1960 to 1968, 437,500 to 409,500. This decrease in license sales, despite a rise in population, can be attributed to several related factors. Perhaps the principal factor is the social change in recreation habits caused by increased urbanization of the basin's population. Urbanization has brought with it many water-use conflicts – reduced access, recreational water-use priorities, water quality problems and others of less significance. The water quality problem involving pollution from many sources, including industrial, agricultural, mining and the aforementioned urban, seriously limits fish production in many basin streams. Lack of adequate promotional and educational programs for fishing may have also contributed to the drop in license sales.

Various fresh-water species are widely distributed throughout the area, many of them occurring in each of the subbasins. The size of water bodies, general geographic location, rates of flow, quality of water and clearness are the principal factors determining the occurrence of species within each basin. Some of the more predominant species include large mouth, small mouth and spotted bass; bluegill; sunfish; crappies drum; catfish; flathead; carp; buffalo; and suckers.

Fishing habitat is provided by 5,900 miles of stream with fishable waters and about 79,000 acres of fishable ponded water of which 54,000 acres were for public use. Of the total fishing area available between 15–25 percent of the total fishing is done in public waters. Figure 61 presents the existing sport fishing habitat that is available in the basin.

Hunting

Under present conditions, the basin contains about 20,800,000 huntable acres of which about 15 percent is in forest lands. The primary game species include the cottontail rabbit, gray and fox squirrels, bobwhite quail, mourning doves, raccoon, whitetail deer, and over twenty-five species of waterfowl. In general, the southern half of the basin has an interspersion of woody cover, cropland and meadow that provides a desirable

edge between food and cover in close proximity. Such a habitat supports relatively good populations of most farm game and non-game species.

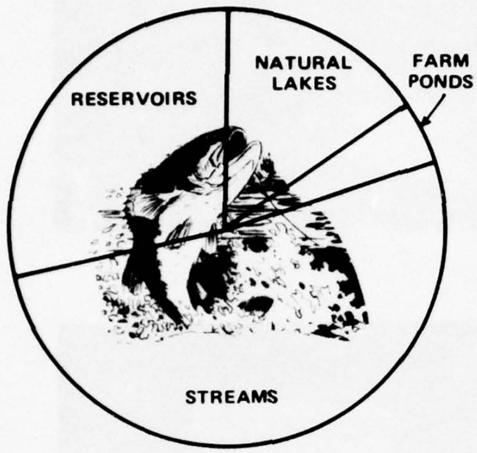


FIGURE 61

EXISTING SPORT FISHING HABITAT

Hunting in the basin could be one of the most widely available outdoor activities in the watershed as small game is relatively plentiful and reasonably well distributed. However, access to good hunting land is limited because of the high proportion of private to publicly owned lands. About 1 percent or 226,000 acres of the basin's huntable lands, are in the public sector; the public areas provide for only 3 percent of the current hunting activity. Hunting has provided an enjoyable source of outdoor recreation for large segments of the resident populations, but in the last several years hunting license sales decreased from 318,000 in 1960 to 266,000 in 1968.

Of the previously mentioned game species, the cottontail rabbit is the most abundant game mammal; the range and abundance of the bobwhite quail approximates that of the cottontail. Migratory waterfowl, ducks and geese, in numbers exceeding a quarter of a million have been recorded in recent years. These birds, in general, follow the Wabash River system which lies within and generally parallel to the Mississippi flyway.

STATE PROGRAMS

Today, water and land resources development and management is a complex system of intergovernmental concern. Activities of the Federal agencies – programs and developments – have been discussed in various detail in the foregoing paragraphs. At the state level, all of the basin states are deeply involved in the planning, development and overall environmental welfare for their respective areas of concern. Appendix M, State Reports, describes the state agencies, their functions and their laws concerning water and land.

It is important to recognize that state laws, policies, and administrative structures do differ from one another and that they have developed in response to local needs. It is important to recognize also that they may be understood and considered in relation to the programs administered for a single set of Federal laws. Under our system of government, all powers not granted to the Federal Government are reserved for the states, and the state water regulations are specifically derived from the general police powers. All of the legislatures of the Wabash River basin have enacted legislation pertaining to water resources which authorized the state agencies to engage in numerous activities, authorizes the creation of various local districts and institutes many regulations pertaining to water use. Similarily, the rights and obligations of individuals and private interests pertaining to surface and ground water, as well as rights of access to lakes and non-navigable streams are regulated largely by the state laws and court decisions.

Within the basin there are all or portions of eleven state forests; 21 state parks, recreation areas, conservation areas, or beaches; 18 state fishing and fish and game areas; 50 public fishing and access sites; and 10 state memorials.

DATA COLLECTION AND PLANNING

Data Collection

In order to have a firm basis for water planning, it has become increasingly important to collect various statistics about people, personal income, personal mobility, stream flows and

ILLINOIS

INDIANA

OHIO

FIGURE 62. STATE DEVELOPMENT

numerous other data. All basin states have continuing programs for data collection, interpretation and basic resources research. Within each subbasin, the total supply of water tends to be a fixed quantity. The demands of an increasing population for this fixed quantity is increasing. Planning and research offers the major opportunities for us to extend these existing supplies. Most of the Basin's states' activities concerning data collection, research and planning are coordinated with Federal investigations or are carried on in cooperation with Federal agencies. These activities range from authorization studies for single-purpose projects to major river basin surveys which involve all multiple-use of land and water. Accordingly, much of the data for this report has its origin in non-Federal sources and was obtained by the Federal agencies from their state level counterparts.

The ongoing programs of the states for planning, research, collecting basic data, and regulatory water resources provides much of the data input for the Federal water programs. Frequent contacts through working relationships of Federal representatives with their state counterparts provides for better understanding of problems and provides a more comprehensive view to all concerned. The Federal-State working relationships have contributed greatly to combining state and Federal programs in the Wabash Comprehensive Basin Plan.

The Wabash Comprehensive Study has depended on data from a multitude of sources – Federal, state, local and individual – the data used for the projects and programs of the study are considered to be of the scope required by the participating agencies for making decisions concerning project selections and program proposals. However, all of the agencies with projects or programs included in the Early Action Plan will later be involved in refining the current studies with more detailed and updated information prior to seeking specific program authorizations. In some respects, the more detailed authorization reports, from which the foregoing refinements will result, will be a part of the continuing general investigation program for water and land resources in the basin. However the timing of the authorization reports will be more critical than most investigations, of the Early Action Plan is to be accomplished in a manner commensurate with the present and foreseeable water needs. A detailed treatment of the authorization report planning and the general implementation of the comprehensive plan is presented in Section VII.

As a matter of detailing, the planning in connection with the future implementation of the *comprehensive plan for the two primary* construction agencies, the Corps of Engineers and Soil Conservation Service, procedures are outlined in the following paragraphs.

a. Projects in the Early Action Plan for which the Corps of Engineers has primary responsibility for planning and construction will be presented in a series of separate reports through the usual agency channels to the Congress for authorization consideration. This is in compliance with the study resolutions previously presented in Section I. Pending authorization and the availability of funds, the projects would be planned in detail, and construction would follow, upon responsible interests providing local cooperation required.

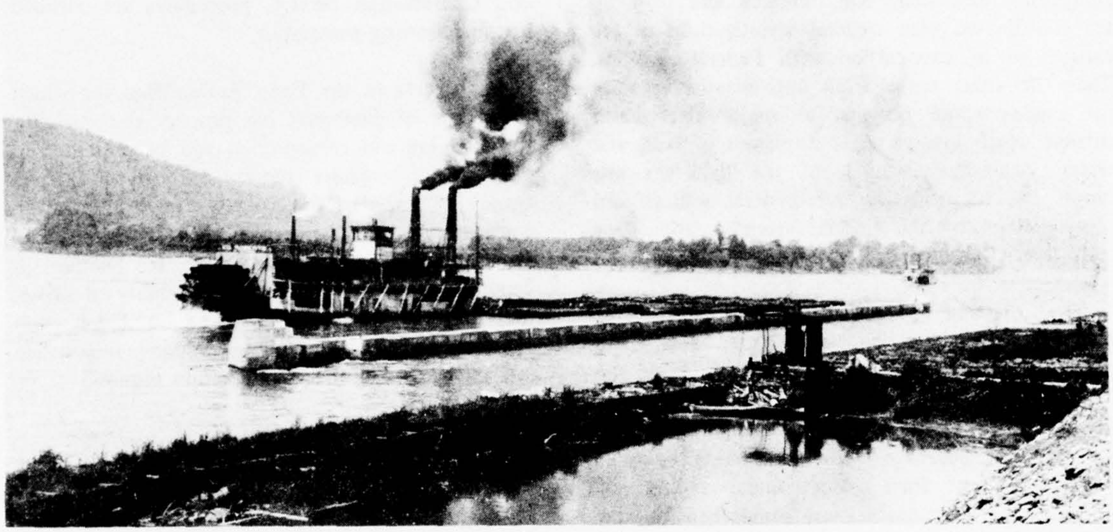
b. Those projects and programs in the 10 to 15 year plan for which the Soil Conservation Service has primary responsibility in planning and assisting will also be presented in agency reports for appropriate authorization. These programs, too, would be constructed when the detailed planning is completed, funds are available and local cooperation requirements are fulfilled.

Currently a navigation study, extending from the mouth of the Wabash to the Great Lakes, is underway; it is designated as the Cross-Wabash Waterway Study. The planning for the waterway was given an initial appropriation to determine if all or any portion of the waterway is feasible, before progressing to more detailed engineering, economic and environmental evaluations.

Physically, navigation is possible; at the present time the river is used at local points along its winding course by small barges, ferries and recreation traffic; historically, as set forth earlier in this report, the Maumee-Wabash route was a superwaterway during the days of the early French traders and settlers.

Various preliminary routes of the projected waterway have been studied for the mouth via

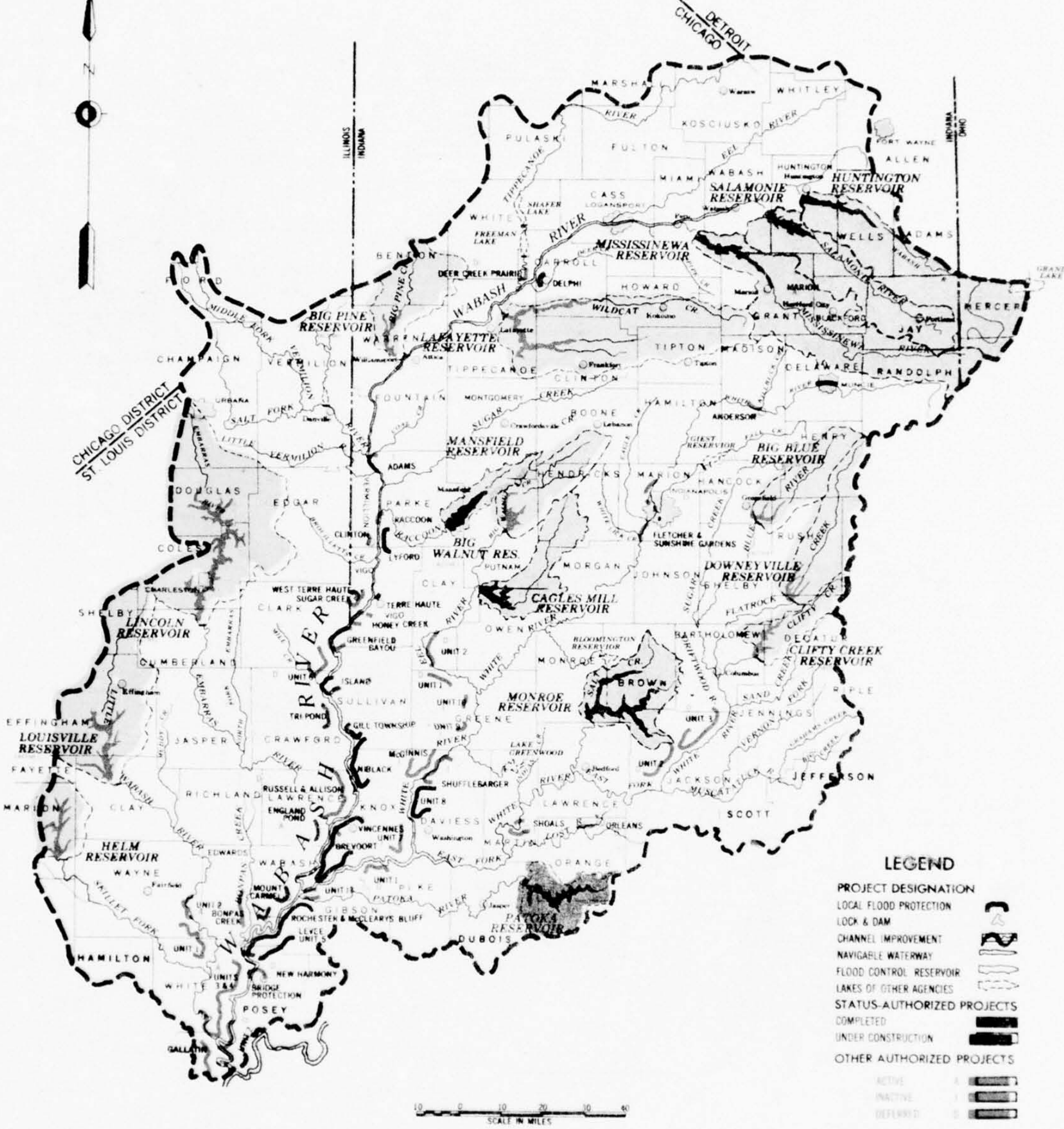
three basic directions to Lakes Michigan and Erie. To present a plan for this immense project or any part of it in this report would be, at best, premature. Just as important to the economics of this region as navigation might be is the environmental impact which such a project may have. If preliminary evaluations of all canal aspects appear favorable, a full environmental study will be conducted to assure complete compatibility of engineering details with the ecosystem of the Wabash Valley – perhaps the most unique green canopy of trees and plantings in the world.



AN EXAMPLE OF EARLY NAVIGATION

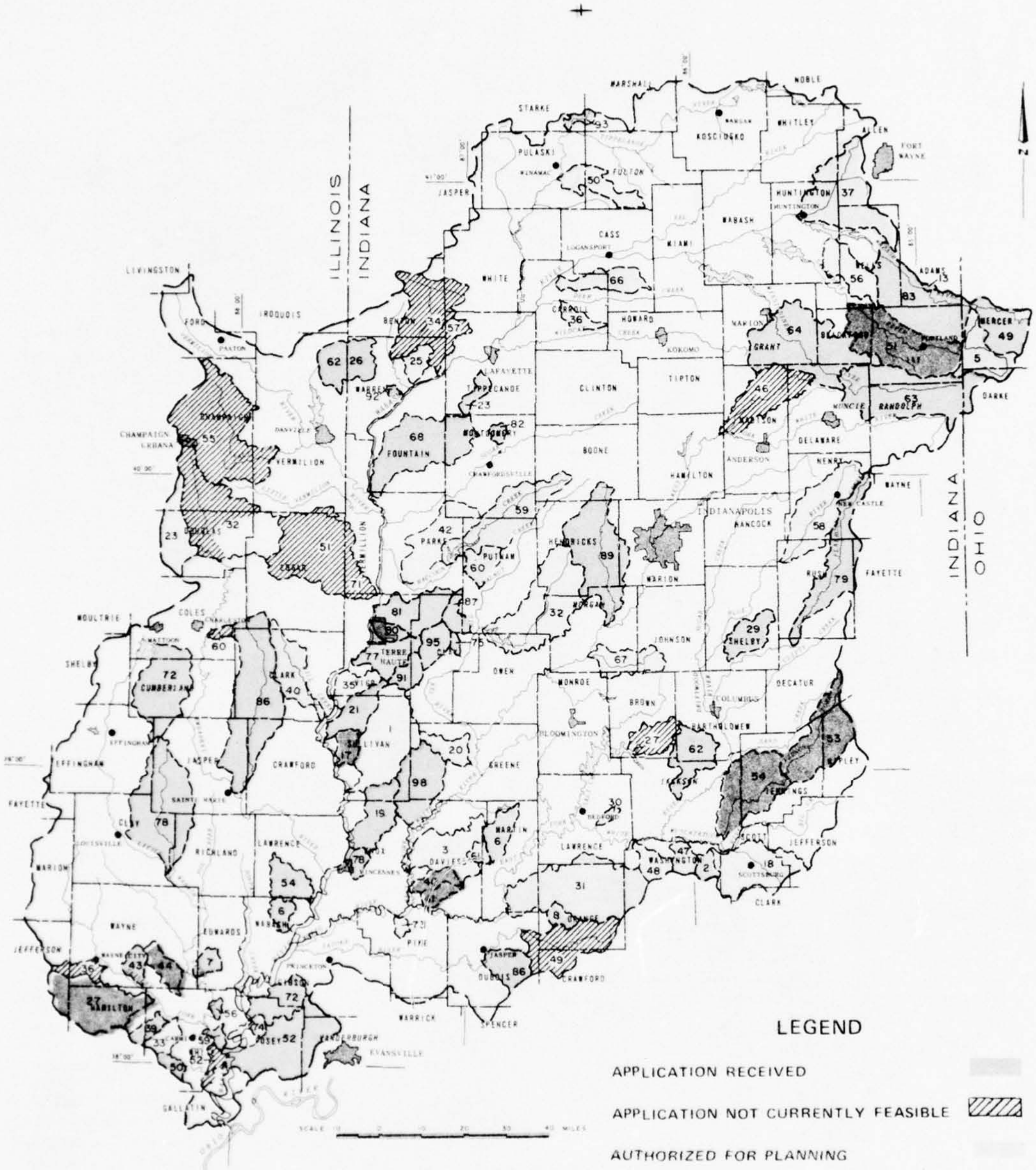
GRAND RAPIDS – AN EARLY NAVIGATION DAM
AT MOUNT CARMEL, ILLINOIS

FIGURE 63



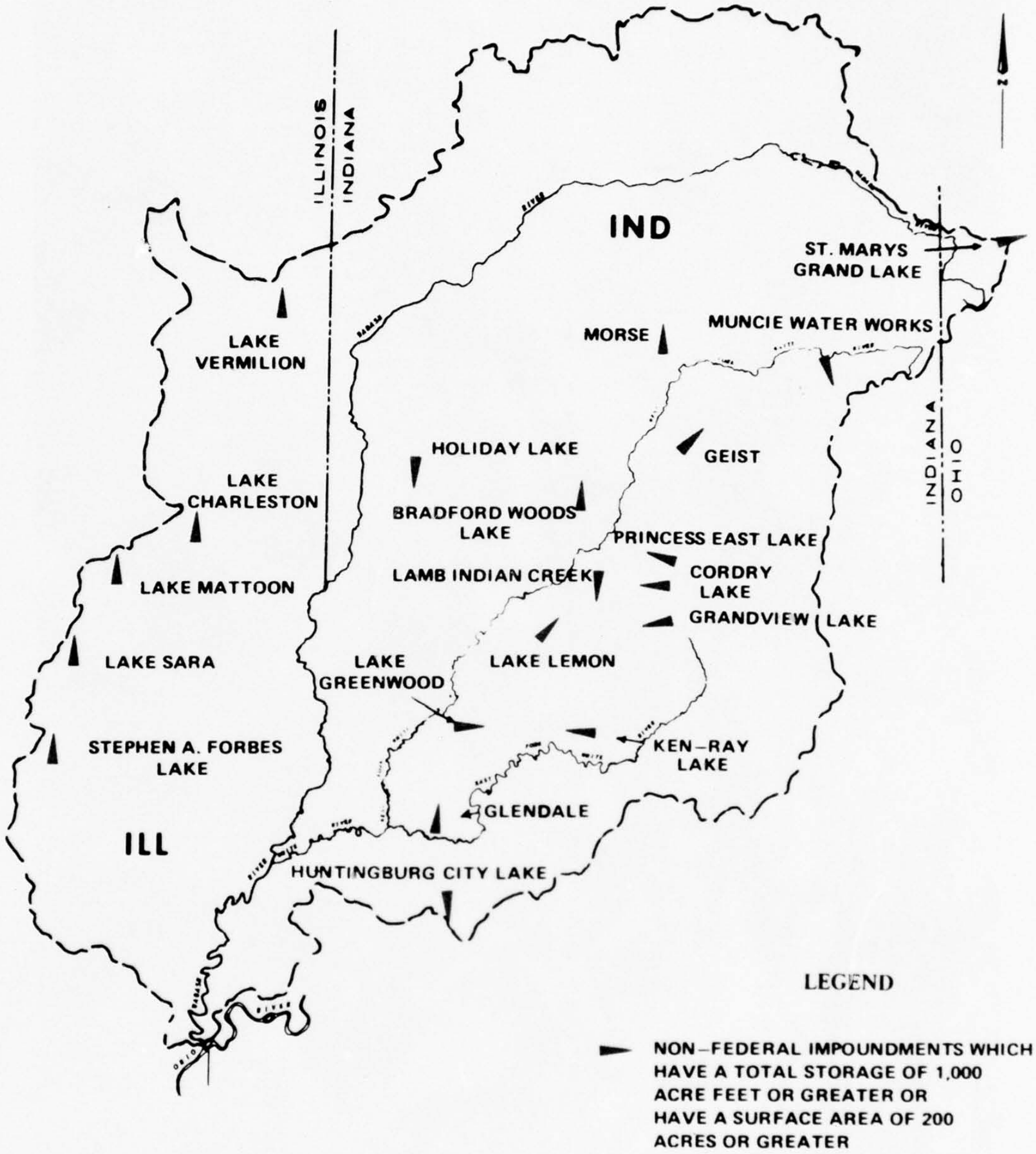
CORPS OF ENGINEERS - 1968 GOING PROGRAM

FIGURE 64



UPSTREAM WATERSHED PROJECTS
1968 GOING PROGRAM

FIGURE 65



STATE PROGRAMS
NON-FEDERAL IMPOUNDMENTS

FIGURE 66

FIGURE 67. A COMMON, YET UNDESIRABLE, SCENE ALONG MANY STREAMS IN THE BASIN

SECTION V – PROBLEMS AND NEEDS

INTRODUCTION

General

The problems and needs associated with water and related land resources in the Wabash area involve many Federal departments and agencies, several regional organizations, numerous agencies in the three states, hundreds of city and county governments and the people of the valley. Ultimately, the goal of identifying the needs of the basin – its governmental organizations and its people – has two immediate purposes: (1) to provide the basis for necessary legislation and executive action; and (2) to serve as a starting point for detailed agency project authorization reports and a future planning guide for agencies, states, localities and individuals.

Water problems, of course, are the result of urbanization, population pressures and industrialization with their competing demands on the region's resources, and at the same time these pressures increase the need for saving quality environmental resources. Problems for our reporting purposes are identified as those of flood prevention, water supply, water quality control, land treatment and management, navigation and environmental resources. Every attempt has been made to explore fully each and every demand that will be placed on the river and its tributaries, as it is clear that the future well-being of the people within the Wabash Basin will depend to a major degree on the availability and control of its waters.

Problems and Needs Perspective

As may be discerned in the foregoing sections, the pattern of sociological development in the Wabash Basin has been typical of that section of our country known as the Middle West. In the 1818 Treaty of St. Marys, the former Indian territory of the Wabash Region was opened to settlement. The rich soils, wooded areas and wildlife made conditions ideal for a self-contained economy, and as a result many small urban centers and rural communities came into being early in the nineteenth century. In 1960, the Wabash subbasin had about 19 percent of the population, 13 percent of the labor force and produced 17.5 percent of industrial output in the parent Ohio River Region.

The western portion of the basin contains large commercial coal deposits and mining output is increasing to keep pace with the growing needs of the electric power industry. As recent as 1930, the labor force was predominantly agricultural, but manufacturing has since become the largest employer. Projective economic studies indicate that the general economy will grow at a rate somewhat commensurate with national growth. Greater use, additional development and increased efficiency in management of water and related land resources, along with diligent prosecution of other programs allied to water and land use will be required to keep abreast of the projected demands for water and related functions and services. The base year, 1968, and projected increases that comprise gross needs for water are summarized in table 29.

The basin has a history of recurring heavy rains from widespread storms, summer thunderstorms with intense rainfall, and occasional tornadoes. Although storms are more frequent during the months of October to April, flood records show that they may occur at any time during the year. Extended droughts, although infrequent, have caused acute water shortages and major crop losses. Agricultural flood damages are particularly significant and comprise 77 percent of the total basin damage. There are three urban centers with flood threats of almost annual consequence; one of these, Indianapolis, Indiana, has the third largest residual annual damage of any city within the parent Ohio River Region.

In general terms, municipal and industrial water supplies are adequate in quantity, but there are some current problems; future 2020 demands will be more than three-fold those of present day. Population concentrations and economic activity in various parts of the basin have resulted in the aggravation of problems associated with municipal and industrial wastes and other stream pollution. Acid drainage from active and abandoned mines has further degraded the streamflow in the Patoka River subbasin and several small tributary streams of the Middle Wabash Subbasin. Chloride problems from oil field brines exist in the lower reaches of the Embarras, Patoka and scattered areas of the Little Wabash Subbasin.

TABLE 29

BASIN NEEDS PERSPECTIVE

Purpose	Present	1980	2020
	Reduction ($1,000)	Damages ($1,000)	
Flood Control	8,570.0	52,759.0	90,401.0
		Quantity (Million Gallons per Day)	
Water Supply			
Municipal and Industrial	498.3	658.0	1,649.0
Rural	145.4	173.5	253.3
Water Quality	1,130.0 3/	3,210.0 3/	6,820.0 3/
		Quantity (1,000 Acre-feet)	
Electric Power			
Cooling	1,876.5	3,008.2	35,238.0
Diversion	1,103.2	572.7	434.8
Consumptive Use	17.9	34.5	434.8
Navigation	—	1/	1/
Irrigation	8.2	12.9	24.8
		Quantity (1,000 Acres)	
Drainage	3,987.0	2,542.0	3,550.0
Land Treatment			
Cropland	10,388.5	6,456.0	2,679.0
Pasture	1,390.2	901.0	349.0
Forest	2,109.1	680.0	1,142.0
Urban	—	216.0	823.0
Other	336.9	208.0	95.0
		Quantity (1,000,000 Annual Recreation Days)	
Environmental Resources			
Recreation	37.6	42.6	126.1
Fish and Wildlife	12.5	15.9	20.9
Historical, Archaeological, Natural and Related Resources	—	2/	2/

1/ Unidentified: Cross Wabash Waterway Study is underway.
2/ Inventoried for report studies; see Report Recommendations.
3/ Based on at least 90% BOD removal from waste waters in the communities involved. The flow need listed is that which is needed to receive the treated wastes.

Coal mining with large coal reserves in the central part of the subbasin, together with the energy producing and other industries, depend on the availability of low-cost transportation for the movement of bulk commodities – coal, petroleum, fertilizers, grain and a host of others. All of the ingredients for a possible navigation project are here; currently, a navigation study, extending from the mouth of the Wabash to the Great Lakes is underway – the Cross-Wabash Waterway Study encompassing engineering, economic and environmental evaluations for a partial or total canalization.

Demand for water oriented outdoor recreation in the Wabash Basin exceeds all other tributary basins of the Ohio River. The unusually high demand is directly related to the large population situated within a reasonable zone of influence. Primary population centers which circumscribe the area are St. Louis, Missouri; Springfield, Decatur, Peoria and Chicago, Illinois; Toledo, Dayton, and Cincinnati, Ohio; Louisville, Kentucky; Gary, Hammond, East Chicago, South Bend, and Fort Wayne, Indiana. Champaign-Urbana, Illinois and Terre Haute, Lafayette, Anderson, Muncie and Indianapolis, Indiana are major population centers within the Wabash Basin. If predicted future recreational desires are to be satisfied, further sources of opportunity will be required.

FLOOD CONTROL

Introduction

The Wabash Basin has been inhabited by civilized man since the latter part of the seventeenth century, long before our technology was capable of erecting effective flood control structures, instituting land treatment or establishing conservation measures. The river, by its very nature, runs out of its banks and sometimes spreads over the vast expanses of flat bottomland which have been washed and deposited over throughout geologic time. During the settlement period the frontiersmen gained an acute awareness of the valley's flood characteristics, and it is probably these early experiences that led to the location of most of the Basin's urban areas in less flood-prone locations. Despite this fact, devastating floods have resulted in loss of life, human suffering and have created economic hardship in the basin since its earliest settlement. In any assessment of water resource needs, flood control has a peculiar role, as it deals primarily with water that is in excess of tolerable stream limits and in excess of requirements.

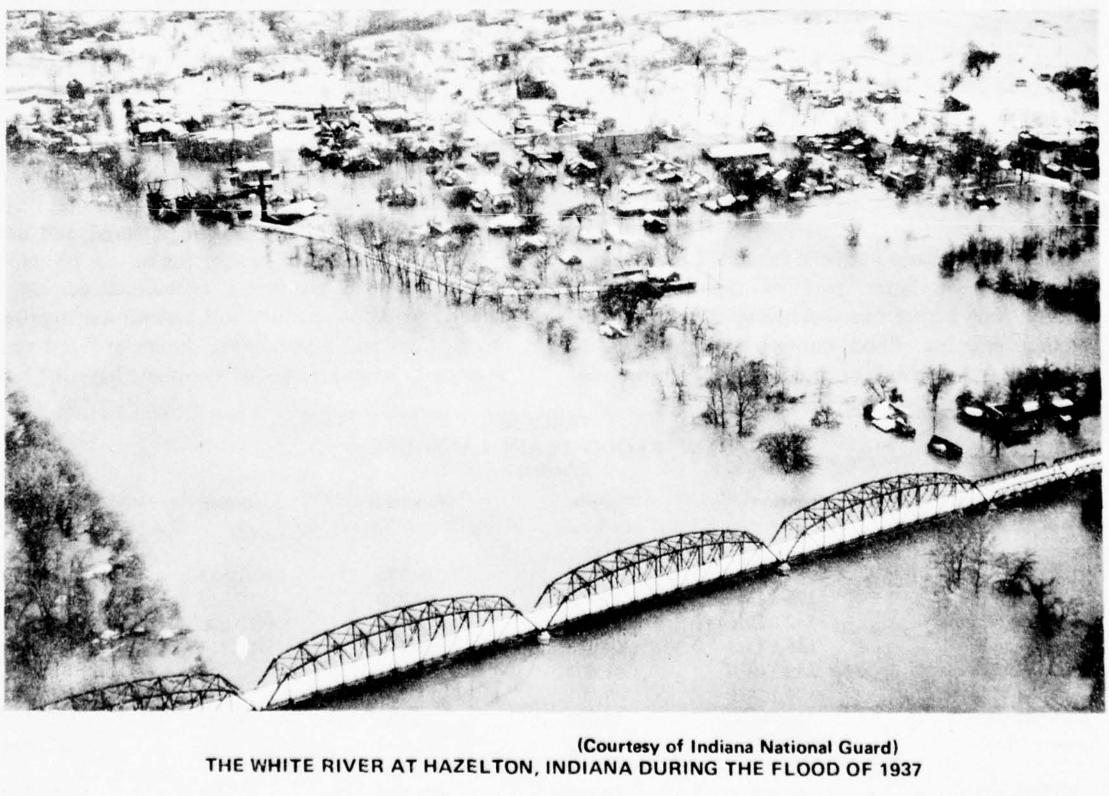
Flood Plain

The flood plains of the basin encompass an estimated 2,264,000 acres or one-third of the flood plain lands in the parent Ohio River basin. About 852,000 acres of these lands are in the upstream watershed areas. Land use in both the upstream and downstream flood plain areas is estimated to be as indicated in table 30. Located within this area is some of the most productive farm land in the middle west, as well as portions of 33 urban centers. Nine railroads and numerous highway transportation routes cross the flood plain areas, most of them are below record flood levels at one or more points. Eleven percent, or 353,100 acres, of the Basin's forest land is located in the flood plain; these stands have a high growth potential, and they are a valuable source of timber for various products. The major flood problem is agricultural damage – damage to crops, pasture and agricultural improvements. Corn and soybeans are the major flood plain crops, with lesser acreages of wheat and hay.

TABLE 30
PRESENT FLOOD PLAIN LAND USE
(Acres)

Hydrologic Subbasin	Cropland	Pasture	Woodland	Other	Total
Patoka	53,965	2,784	20,775	1,595	79,119
East Fork White	271,243	22,703	87,210	10,839	391,995
West Fork White	342,025	22,720	46,120	20,006	430,871
Upper Wabash	136,802	24,043	30,144	18,517	209,506
Middle Wabash	359,349	21,801	80,453	10,405	472,008
Embarras	109,125	9,001	23,275	3,524	144,925
Little Wabash	248,201	20,671	72,386	5,987	347,245
Lower Wabash	193,570	6,683	64,392	2,986	267,631
TOTAL	**1,714,280**	**130,406**	**424,755**	**73,859**	**2,343,300**

THE SALAMONIE RIVER AT PORTLAND, INDIANA DURING THE FLOOD OF 1913



(Courtesy of Indiana National Guard)
THE WHITE RIVER AT HAZELTON, INDIANA DURING THE FLOOD OF 1937

FIGURE 68

Historic Basin Floods

The preservation of the region's knowledge about past floods is the key to all methods of flood damage reduction. Although floods have always occurred, significant flood damage to man and property has resulted only because of man's occupation and utilization. As the Basin's communities and agricultural operations have increased in size, particularly in this century, the value of property has also increased until great damage is caused by floods of magnitudes which formerly produced only minor inconveniences.

Floods in the basin have occurred in every month of the year, but those of summer and fall ordinarily have less areal coverage than those of winter and spring. Since the August 1875 high water, all major floods have occurred in the winter and spring months. The March 1913 flood was the most devastating runoff period in the history of the basin. In this century, there have been eighteen major floods; the most significant of these from the standpoint of areal coverage in descending order of magnitude, occurred in March 1913, May 1943, January-February 1950, May 1933, March 1939 and January 1930. The record 1913 flood under today's prices and levels of development would cause damage estimated at $127 million dollars. Data pertinent to record floods are presented in table 31.

Flood Damages Existing Conditions

For an assessment of flood control needs in the basin, flood damage studies were conducted in the downstream mainstem areas by the Corps of Engineers and in the upstream tributary areas by the Soil Conservation Service; the results of these studies are consolidated and summarized in table 32. Essentially flood losses over the past years of flood record have been moderately heavy when compared with the total value of all property holdings located within the flood plain. These losses have prevented the development of the lower lying urban areas and the full utilization of many acres of highly fertile agricultural land which is covered by floodwaters at frequent intervals. The urban property in the flood plain of the Wabash River accounts for a major portion of the total worth of all holdings. However, as most of these improvements are beyond the reach of frequent floods, they suffer only about 11 percent of the total damage. When statistically measured on an average annual basis, the heaviest damages are agricultural consisting of crop and non-crop losses. The average annual non-crop damages are the losses sustained in rural areas caused by erosion, sanding, bank cutting, destruction of real property, fence, livestock, stored crops, gardens, machinery and other farm related items. Other known losses are suffered by railroads, highways, utilities, oil and gas properties, urban areas and levees. The indirect flood damages which result from the direct losses are difficult to evaluate, and for this report, a straight ten percent increase in direct damages was applied for the upstream areas only – for these areas, damages were more precisely defined and the aforementioned percentage increase appeared reasonable as a basin average. Estimated damages are broken down into the various categories of damages in table 33.

It should be mentioned that the flood damage estimates are based on actual field surveys which have been conducted over the period of the comprehensive study. In addition to actual damage estimates, other data are also collected; these include the cost of producing crops, value of harvested crops the effects of inundation for varying

TABLE 31

DATA ON RECORD FLOODS

Date	Stream and Reach	Index Station	Stage (Feet)	1968 Damage Potential
March 1913	Patoka River, P-6	Jasper, Ind	15.9	$ 752,000
June 1960	East Fork White River, EW-5	Columbus, Ind	10.37	102,000
March 1913	West Fork White River, Indianapolis, Ind	Indianapolis, Ind	30.0	22,318,000
June 1958	Upper Wabash River, W-10	Wabash, Ind	22.46	496,000
June 1958	Middle Wabash River, W-4	Terre Haute, Ind	29.25	6,685,000
May 1961	Embarras River, EM-1	Ste. Marie, Ill	25.08	1,816,000
May 1961	Little Wabash River, LW-1	Carmi, Ill	36.70	1,005,000

THE FLOOD OF 1961 ON THE WABASH RIVER AT MT. CARMEL, ILLINOIS

(Courtesy of Jasper Herald)
THE PATOKA RIVER AT JASPER, INDIANA DURING THE FLOOD OF 1964

FIGURE 69

lengths of time and in different seasons and property value. The conversion of damage for specific floods to an annual basis is accomplished through use of flood frequencies determined essentially from records of past floods and the use of damage values obtained from field surveys adjusted when necessary to account for the present state of development in the flooded area. Damages for future time periods reflect the projected economic growth of the area and the capability of the flood plain in certain areas to sustain further economic development.

TABLE 32
PRESENT AVERAGE ANNUAL FLOOD DAMAGES, UPSTREAM AND DOWNSTREAM AREAS
(Thousands of Dollars)

Subbasin	Upstream	Downstream	Total
Patoka	321.2	1,780.9	2,102.1
East Fork White	2,918.2	5,069.8	7,988.0
West Fork White	2,343.0	9,472.4	11,815.4
Upper Wabash	2,309.2	470.7	2,779.9
Middle Wabash	2,049.3	3,269.2	5,318.5
Embarras	1,163.3	1,617.9	2,781.2
Little Wabash	1,549.5	2,354.9	3,904.4
Lower Wabash	835.9	1,809.5	2,645.4
TOTAL	**13,489.6**	**25,845.3**	**39,334.9**

Need for Flood Plain Regulation

Throughout the basin, despite the hazard of recurring floods, there has been a steady encroachment on the flood plain for urban and agricultural purposes, including residential dwellings, farm buildings, commercial establishments and industrial complexes. All three basin states and a number of communities have taken some action toward flood plain regulation. Communities have enacted ordnances establishing channel limits, encroachment lines or general flood zones along streams within their corporate limits. The need for flood plain regulation is accentuated by the fact that damages from future floods can be minimized by the exercise of foresight in development along many of the river reaches by limiting the purposes of flood plain use, by flood proofing structures and by similar damage prevention measures.

Potential Flood Damages

With the assumption that present flood damage trends will continue and risks will be ignored the Flood Damage Reduction Task Force estimated potential average annual flood damages, considering subarea projections of progressive economic development in the flood plain from 1960 through 2020 and with flood control projects in operation as of 31 December 1968. In the projections and specifically in the determination of composite growth factors in each reach of the mainstem streams and upstream areas, evaluations were given

TABLE 33
PRESENT AVERAGE ANNUAL FLOOD DAMAGES BY CATEGORY
(Thousands of Dollars)

Subbasin	Crop and Pasture	Agriculture	Transportation	Urban	Other	Total
Patoka	1,350.6	254.7	70.1	202.0	224.7	2,102.1
East Fork White	4,602.0	1,545.0	623.0	890.0	328.0	7,988.0
West Fork White	4,967.7	2,816.3	1,152.8	2,605.8	272.8	11,815.4
Upper Wabash	2,051.9	178.1	59.6	287.5	202.8	2,779.9
Middle Wabash	2,928.3	1,458.7	337.6	290.6	303.3	5,318.5
Embarras	1,878.6	406.5	209.1	116.6	170.4	2,781.2
Little Wabash	2,876.7	524.1	230.2	113.9	159.5	3,904.4
Lower Wabash	1,501.8	938.6	91.9	5.9	107.2	2,645.4
TOTAL	**22,157.6**	**8,122.0**	**2,774.3**	**4,512.3**	**1,768.7**	**39,334.9**

to all foreseeable trends as population growth, employment trends, foreseeable impacts of manufacturing and new construction, agricultural production trends and, in general, all known forecasts of socio-economic developments that might occur. Table 34 lists the estimated annual damages under projected economic development by each subarea for both upstream and downstream areas, current average annual damage for the same tabular breakdown are listed for comparison. It should be mentioned that the procedures used to estimate existing flood damages, as well as projected damages, were accomplished with less than survey report accuracy due essentially to the length of tenure over which the information was secured. However, the data were considered commensurate with the objectives to secure a comprehensive water and land resources plan for the basin. The projected residual flood damages for both upstream and downstream areas are illustrated in figure 70.

WATER SUPPLY

The objective of any water supply assessment is to give perspective to the adequacy of the water resources to meet present and future demands. Development of water resources has long played a significant role in the ascendancy of the Wabash Basin to its present standard of living. Of course, water needs and problems have attracted attention from time to time; but they have usually been local in nature. On an average day almost 2 billion gallons of fresh water are withdrawn from Wabash streams, lakes, reservoirs and from underground sources.

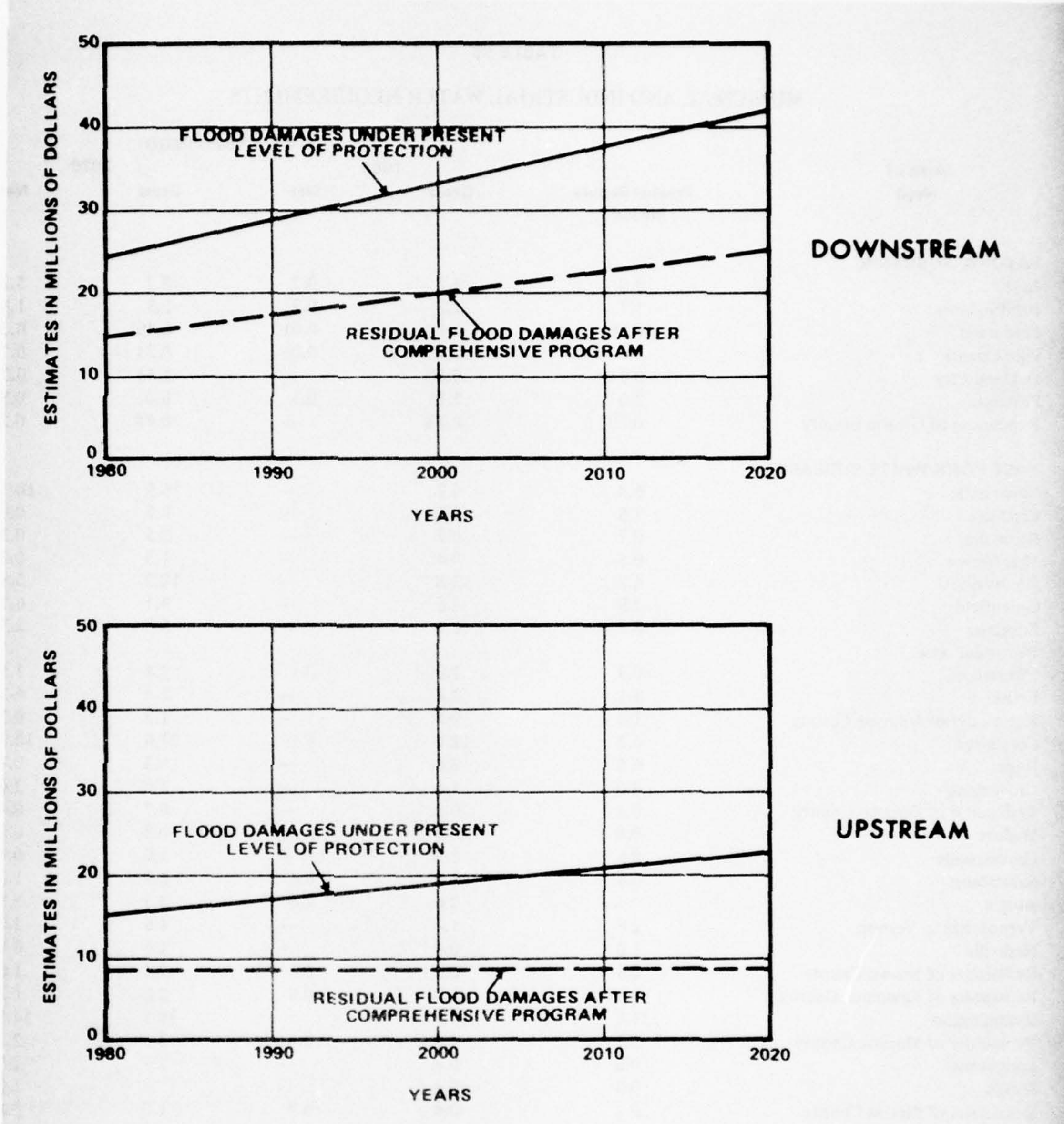
Projections for the Wabash River basin indicate that the major water withdrawals are expected to increase over 200 percent by 2020 and comsumption will increase by about 250 percent. The greatest withdrawal will be for electric power cooling, increasing from the present use of 1.6 billion gallons per day to 30.0 billion gallons per day by 2020.

Municipal and Industrial

Population growth and per capita consumption are the most important factors affecting total future municipal water requirements. These requirements include water for domestic purposes, fire fighting, street cleaning, lawn care and for industry and commerce. The projected increase in population and industrial expansion must of necessity be closely supported by a water supply that is sufficient in both quantity and quality and at a reasonable cost. In the basin, the problems of meeting future requirements are new supplies, distribution, water quality and variability of flow, which all become more critical as population and the economy grow. Water supply can become a problem throughout the basin if water resources are not developed sufficiently to satisfy projected needs. In the Wabash River basin, about 500 million gallons of water per day (mgd) were used in 1968 for municipal and industrial purpose. The requirements, as shown in figure 71, are expected to increase to about 660 mgd by 1980, 1,180 by 2000 and 1,650 by 2020. Areas having known present and anticipated future municipal water supply problems are listed in table 35.

TABLE 34
PROJECTED FLOOD DAMAGES
(Thousands of Dollars)

Subbasin	1968 Downstream	1968 Upstream	1980 Downstream	1980 Upstream	2020 Downstream	2020 Upstream
Patoka	1,780.9	321.2	2,507.9	434.8	4,402.0	621.2
East Fork White	5,069.8	2,918.2	7,134.6	3,748.7	13,489.5	5,486.2
West Fork White	9,472.4	2,343.0	14,140.5	2,357.1	20,462.9	12,028.7
Upper Wabash	470.7	2,309.2	628.2	3,012.2	1,681.2	4,190.8
Middle Wabash	3,269.2	2,049.3	4,211.9	2,311.8	6,345.8	3,622.7
Embarras	1,617.9	1,163.5	2,162.2	1,487.1	3,429.1	1,957.8
Little Wabash	2,354.9	1,549.5	3,123.2	2,081.3	4,826.6	2,807.9
Lower Wabash	1,809.5	835.9	2,316.3	1,096.5	3,089.9	1,649.6
TOTAL	**25,845.3**	**13,489.6**	**36,224.8**	**16,529.2**	**57,727.1**	**32,364.9**



PROJECTED RESIDUAL FLOOD DAMAGES

FIGURE 70

TABLE 35

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Area of Need	Present Supply (MGD)	Average Needs (MGD) 1980 Gross	1980 Net	2020 Gross	2020 Net
PATOKA SUBBASIN					
Jasper	3.0	3.2	0.2	8.2	5.2
Huntingburg	1.1	1.2	0.2	2.9	1.8
Ferdinand	0.16	0.17	0.01	0.46	0.30
Pike County	0.07	0.13	0.06	0.31	0.24
Oakland City	0.64	0.50	—	1.41	0.77
Princeton	2.0	2.2	0.3	6.0	0.39
Remainder of Gibson County	0.19	0.18	—	0.48	0.29
EAST FORK WHITE SUBBASIN					
New Castle	6.8	6.2	—	16.9	10.1
Carthage	9.5	5.1	—	8.7	0.9
Rushville	2.7	0.9	—	2.5	0.3
Morristown	0.5	0.4	—	1.3	0.8
Shelbyville	4.7	3.8	—	10.2	5.5
Greenfield	2.9	2.6	—	9.1	6.2
Edinburg	3.5	2.1	—	5.8	2.3
Whiteland-New Whiteland	0.9	1.0	0.1	2.4	1.5
Franklin	3.1	2.4	—	7.4	4.3
Remainder of Johnson County	1.0	0.8	—	1.2	0.2
Columbus	6.3	12.4	6.1	37.0	30.7
Hope	0.5	0.4	—	1.2	0.7
Greensburg	2.0	1.6	—	4.6	2.6
Remainder of Decatur County	0.3	0.3	—	0.7	0.4
Medora	0.8	0.3	—	0.8	0.1
Crothersville	0.6	0.3	—	1.0	0.4
Scottsburg	0.6	1.0	0.4	1.9	1.3
Austin	—	2.6	2.6	5.3	5.3
Vernon-North Vernon	2.6	1.4	—	4.6	2.0
Nashville	1.0	0.4	—	1.6	0.6
Remainder of Brown County	0.5	0.6	0.1	2.1	1.6
Remainder of Lawrence County	0.80	1.7	0.9	2.0	1.2
Bloomington	24.0	14.5	—	38.7	14.7
Remainder of Monroe County	1.3	1.8	0.5	3.6	2.3
Loogootee	0.8	0.8	—	3.7	2.9
Shoals	0.3	0.3	—	1.3	1.0
Remainder of Martin County	0.2	0.4	0.2	1.0	0.8
Washington County	0.1	0.1	—	0.3	0.2
Orleans	0.5	0.3	—	0.8	0.3
Paoli	0.3	0.7	0.4	2.2	1.9
West Baden-French Lick	—	0.7	0.7	1.6	1.6
WHITE RIVER AND WEST FORK WHITE RIVER SUBBASIN					
Winchester	1.4	2.0	0.6	6.7	5.3
Remainder of Randolph County	0.6	0.3	—	0.7	0.1
Mount Summit	1.0	1.2	0.2	1.8	0.8
Middletown	0.3	0.3	—	0.8	0.5
Muncie	18.8	21.6	2.8	58.0	39.2
Chesterfield	0.5	0.4	—	0.9	0.4
Anderson	34.4	24.0	—	55.7	21.3
Alexandria	1.6	1.9	0.3	4.9	3.3
Summitville	0.8	0.4	—	0.9	0.1
Orestes	0.4	0.4	—	1.0	0.6
Frankton	0.2	0.2	—	0.5	0.3

TABLE 35

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS (CONTINUED)

Area of Need	Present Supply (MGD)	Average Needs (MGD) 1980 Gross	1980 Net	2020 Gross	2020 Net
WHITE RIVER AND WEST FORK WHITE RIVER SUBBASIN (CONTINUED)					
Elwood	3.2	3.5	0.3	8.0	4.8
Lapel	0.4	0.3	—	0.7	0.3
Tipton	1.8	1.2	—	2.6	0.8
Remainder of Tipton County	0.2	0.2	0.6	0.7	0.7
Noblesville	3.6	2.5	—	4.2	0.6
Cicero	0.3	0.2	—	0.5	0.2
Westifield	0.2	0.2	—	0.5	0.3
Remainder of Hamilton County	0.8	0.4	—	0.9	0.1
Indianapolis	52.0	174.0	14.0	360.0	200.0
Remainder of Boone County	0.3	0.1	—	0.4	0.1
Brownsburg	1.1	0.7	—	3.1	2.0
Plainfield	1.7	1.0	—	4.0	2.3
Danville	2.0	0.6	—	2.2	0.2
Mooresville	1.0	0.6	—	1.5	0.5
Martinsville	1.3	1.0	—	4.0	2.7
Industries in Monroe County	0.4	0.6	0.2	1.2	0.8
Greencastle	6.2	4.7	—	15.0	8.8
Putnamville-State Farm	0.2	0.7	0.5	1.2	1.0
Remainder of Putnam County	0.2	0.2	—	0.4	0.2
Brazil	3.0	1.9	—	6.1	3.1
Remainder of Clay County	0.4	0.2	—	0.5	0.1
Jasonville (Hymeria)	0.6	0.3	—	1.0	0.4
Linton (Dugger)	1.5	0.7	—	2.3	0.8
Odon	0.3	0.4	0.1	0.8	0.5
Washington	4.0	2.4	—	5.8	1.8
Remainder of Daviess County	0.4	0.2	—	0.6	0.2
Bicknell	1.2	0.6	—	1.6	0.4
Pittsboro	0.4	0.2	—	0.6	0.2
UPPER WABASH RIVER SUBBASIN					
St. Henry, Ohio	0.70	0.42	—	1.10	0.4
Roanoake	0.37	0.26	—	0.50	0.13
Huntington	15.4	4.7	—	19.1	3.7
Andrews	0.50	0.32	—	0.55	0.05
Bluffton	5.0	2.5	—	6.2	1.2
Portland	2.7	3.2	0.05	7.5	4.8
Dunkirk	0.9	0.90	—	2.30	1.4
Union City	2.6	1.4	—	6.0	3.4
Saratoga	0.37	0.7	0.33	1.7	1.3
Albany	0.50	0.36	—	0.73	0.23
Eaton	0.36	0.30	—	0.58	0.22
Hartford City	3.0	4.5	1.5	12.4	9.4
Fowlerton	0.20	0.22	0.02	0.57	0.37
Gas City	0.90	1.5	0.6	3.7	2.8
Fairmount	1.9	0.6	—	1.4	0.5
Marion	22.5	13.5	—	36.6	13.5
Swayzer	0.9	0.45	—	1.5	0.6
Point Isabel	0.2	0.31	0.11	1.3	1.1
Remainder of Grant County	0.58	0.49	—	0.86	0.26
Lagro	0.5	0.70	0.2	1.5	1.0
Wabash	7.1	5.7	—	15.1	8.0
North Manchester	2.1	1.4	—	2.6	0.5
Warsaw	5.2	4.6	—	11.8	6.6
Mentone	0.7	0.25	—	0.71	0.01
Churubusco	0.6	0.20	—	1.1	0.5

TABLE 35

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS (CONTINUED)

Area of Need	Present Supply (MGD)	Average Needs (MGD) 1980 Gross	1980 Net	2020 Gross	2020 Net
UPPER WABASH RIVER SUBBASIN (CONTINUED)					
Columbia City	1.6	1.20	—	4.0	2.4
South Whitley	1.2	0.60	—	2.0	0.8
Remainder of Whitley County					
Remainder of Marshall County	0.43	0.18	—	0.38	—
Peru	43.2	3.3	—	8.8	4.3
Akron	0.34	0.20	—	0.80	0.46
Rochester	3.10	1.30	—	3.80	0.7
Remainder of Fulton County	0.21	0.13	—	0.36	0.15
Winamac	1.0	0.67	—	3.3	2.3
Remainder of Pulaski County	0.88	0.28	—	0.58	—
Galveston	0.66	0.34	—	0.8	0.14
Greentown	0.14	0.32	0.18	0.54	0.40
Kokomo	12.5	33.1	20.6	84.8	72.3
Tipton County	—	0.16	—	0.42	0.02
Frankfort	8.5	3.9	—	9.4	0.9
Remainder of Clinton County	0.42	0.31	—	0.58	0.16
Flora	1.2	0.42	—	1.4	0.2
Delphi	2.3	0.66	—	2.4	0.1
Monticello	2.0	1.4	—	3.1	1.1
Monon	0.50	0.27	—	0.68	0.18
Remainder of White County	1.08	0.48	—	1.18	0.1
Lafayette Area	43.5	32.8	—	85.1	41.6
MIDDLE WABASH RIVER SUBBASIN					
Lebanon	3.0	0.90	—	3.4	0.4
Remainder of Boone County	0.34	0.17	—	0.54	0.20
Fowler	1.6	0.62	—	2.2	0.60
Rural Warren County Industry	3.8	7.4	3.6	34.8	31.0
Remainder of Warren County	0.08	0.16	0.08	0.38	0.30
Attica	2.4	2.5	0.1	5.2	2.8
Remainder of Fountain County	0.21	0.16	—	0.27	0.06
Crawfordsville	3.0	5.5	2.5	18.3	15.3
Remainder of Putnam County	0.38	0.26	—	0.40	0.02
Rockville	1.4	0.57	—	1.8	0.04
Remainder of Parke County	0.59	0.40	—	1.19	0.60
Rural Vermilion County Industry	11.5	4.1	—	31.6	20.1
Terre Haute	30.8	43.0	12.2	126.5	95.7
Sullivan	1.4	1.0	—	2.1	0.7
Remainder of Sullivan County	0.17	0.10	—	0.26	0.09
Vincennes	9.1	8.3	—	22.4	13.3
Remainder of Knox County	0.30	0.18	—	0.42	0.12
Paxton	1.6	0.80	—	1.4	0.10
Hoopeston	2.9	3.5	0.60	7.1	4.2
Roseville	1.0	0.80	—	1.4	0.40
Danville	8.0	16.4	8.4	43.8	35.8
George town	1.0	1.1	0.1	2.5	1.5
Rantoul	2.0	1.7	—	3.2	1.2
Champaign	23.0	16.0	—	32.5	9.5
Remainder of Champaign County	1.3	0.77	—	1.52	0.22
Paris	0.9	2.9	1.5	8.8	6.4
Marshall	2.7	2.0	—	1.2	4.5
Remainder of Clark County					
Robinson	3.3	5.4	2.1	12.7	9.4
Remainder of Lawrence County	0.06	0.16	0.10	0.25	0.19
Remainder of Wabash County	0.05	0.07	0.02	0.15	0.10

TABLE 35

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS (CONTINUED)

Area of Need	Present Supply (MGD)	Average Needs (MGD) 1980 Gross	1980 Net	2020 Gross	2020 Net
EMBARRAS RIVER SUBBASIN					
Champaign County	0.83	0.45	—	0.95	0.12
Edgar County	0.47	0.19	—	0.39	—
Tuscola	0.46	0.46	—	1.25	0.79
Arcola	0.23	0.42	0.19	1.50	1.27
Villa Grove	0.33	0.25	—	0.60	0.27
Remainder of Doughs County	0.31	0.12	—	0.32	0.01
Charleston	0.65	2.2	1.55	4.4	3.75
Casey	0.44				
Remainder of Casey County	0.32				
Newton	1.27	0.53	—	1.55	0.28
Remainder of Jasper County	0.09	0.05	—	0.14	0.05
Lawrenceville	2.3	8.18	—	8.70	0.40
LITTLE WABASH SUBBASIN					
Mattoon	4.35	2.9	—	8.1	3.8
Altamont	0.10	0.30	0.20	0.70	0.60
Edgewood (Mason)	0.06	0.07	0.01	0.18	0.12
Dieterich	0.05	0.06	0.01	0.16	0.11
Remainder of Effingham County	0.20	0.14	—	0.33	0.13
Flora	0.70	1.0	0.30	3.7	3.0
Lanesville	0.03	0.13	0.10	0.42	0.39
Clay City	0.09	0.15	0.06	0.51	0.42
Marion County	0.07	0.02	—	0.04	2.4
Olney	3.6	1.94	—	6.02	2.4
Fairfield	2.23	1.34	—	5.11	2.9
Cisne	0.07	0.08	0.1	0.16	0.9
Enfield	0.12	0.08	—	0.16	0.04
Remainder of White County	0.26	0.16	—	0.34	0.08
Gallatin County	0.14	0.07	—	0.20	0.06
LOWER WABASH SUBBASIN					
Remainder of Wabash County	0.10	0.12	0.02	0.24	0.14
Remainder of Richland County	0.03	0.02	—	0.04	0.01
West Salem	0.10	0.10	—	0.28	0.18
Grayville	0.72	0.53	—	1.48	0.76

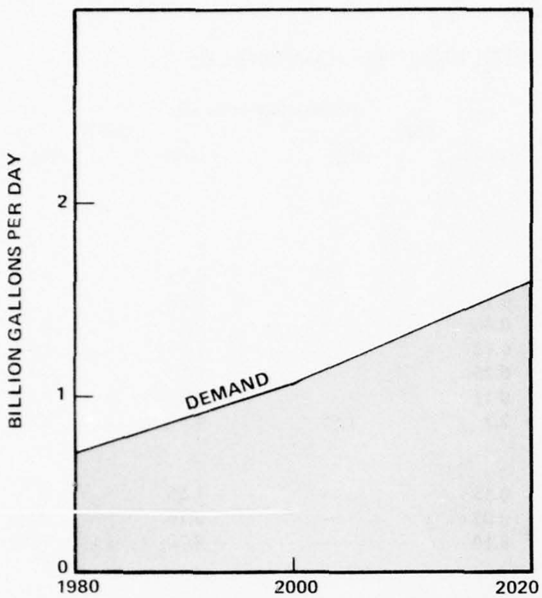


FIGURE 71

MUNCIPAL AND INDUSTRIAL WATER SUPPLY REQUIREMENTS

Rural

Water needs for the rural community, domestic and livestock uses are expected to increase generally because of the projected increases in rural non-farm and livestock populations. Requirements for rural farm domestic or household uses will decrease steadily, although needs in some localized areas may rise because of growing per capita water use. The basin-wide needs for rural farm domestic uses will be 30.4 million gallons per day (mgd) in 1980, 23.4 mgd in 2000 and 16.6 mgd in 2020, see table 36. The overall water supply demand for the rural sector of the basin is shown in figure 73. These are based on farm populations estimated at 314,000, 222,000 and 149,000, respectively. The projected needs reflect an increasing per capita use of water on the one hand and a declining rural farm population on the other. The farm projected population decline outweighs the per capita increase, resulting in a decrease in farm domestic water use from about 35 mgd to about 15 mgd during the projection period.

Increased water supplies for livestock will be required throughout the basin, because of rising

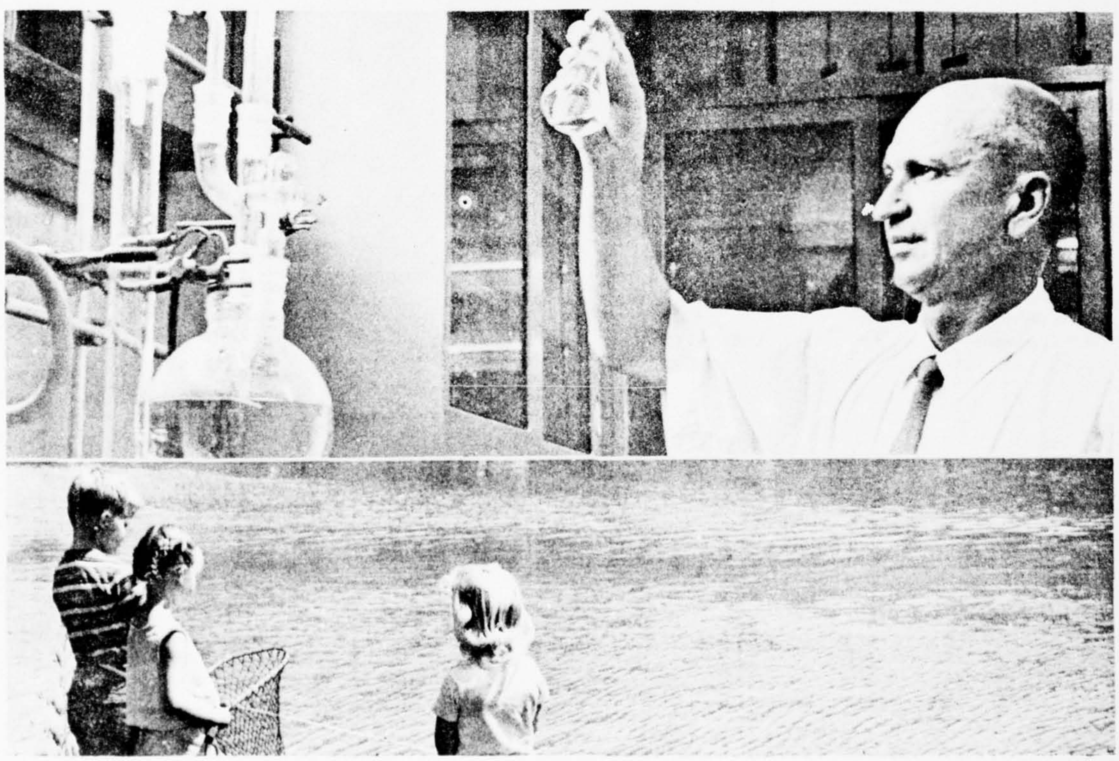


FIGURE 72. BALANCED SOCIO-ECONOMIC GROWTH OF THE BASIN IS DEPENDENT ON ADEQUATE WATER FOR ALL.

production and changes in production technology. The output of livestock products is expected to increase from 1960 levels with average livestock water requirements increasing from about 49 million gallons per day in 1960, to 67 mgd in 1980, 100 mgd in 2000 and 136 mgd in 2020.

TABLE 36

RURAL WATER SUPPLY REQUIREMENTS
(Million Gallons per Day)

Economic Subarea	1960	1980	2000	2020
Rural Farm Domestic 1/				
1	6.54	5.85	4.74	3.38
2	8.92	7.07	5.31	3.70
3	2.79	2.44	1.88	1.37
4	4.85	3.74	2.73	1.79
5	2.12	1.76	1.42	1.05
6	11.44	9.56	7.31	5.28
TOTAL	36.66	30.42	23.39	16.57
Rural Non-Farm Domestic 1/				
1	9.87	12.16	13.22	13.57
2	24.61	30.84	35.52	38.59
3	2.18	3.02	4.06	5.06
4	4.42	6.39	8.39	9.87
5	4.19	5.14	6.15	6.90
6	14.03	18.51	23.08	26.84
TOTAL	59.30	76.06	90.42	100.83
Livestock				
1	9.00	10.98	16.41	22.11
2	11.44	15.83	23.67	32.01
3	3.27	5.41	8.19	11.12
4	6.01	8.42	12.76	17.32
5	3.98	6.66	10.07	13.67
6	15.72	19.74	29.35	39.65
TOTAL	49.42	67.04	100.45	135.88
Totals				
1	25.41	28.99	34.37	39.06
2	44.97	53.74	64.50	74.30
3	8.24	10.87	14.13	17.55
4	15.28	18.55	23.88	28.98
5	10.29	13.56	17.64	21.62
6	41.19	47.81	59.74	71.77
TOTAL	**145.38**	**173.52**	**214.26**	**253.28**

1/ Not served by municipal water systems.

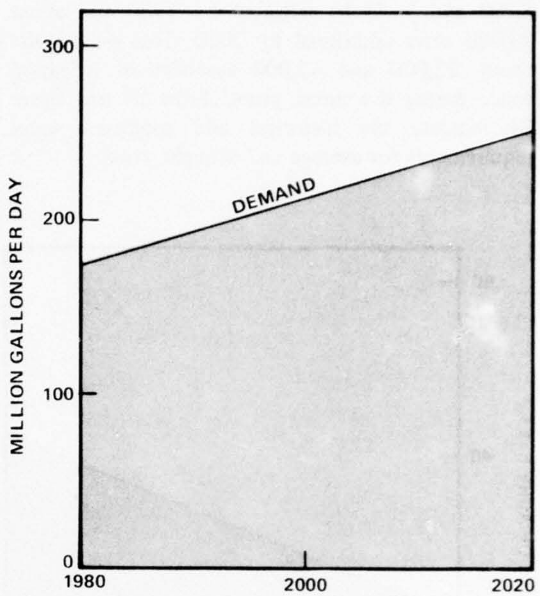


FIGURE 73

RURAL WATER SUPPLY REQUIREMENTS

Water needs for rural non-farm domestic uses are expected to rise as per capita use increases and the rural non-farm population grows from 1,009,000 in 1960 to 1,482,000 in 1980, 2,016,000 in 2000, and 2,350,000 in 2020. The rural non-farm domestic needs will be 142 million gallons per day in 1980, 211 mgd in 2000, and 260 mgd in 2020, as compared with 86 mgd in 1960.

Other Water Needs

The projective economic studies for the agricultural sector included analyses of the potential for achieving greater efficiency in agricultural production through irrigation along with the other types of water and land resource developments. These studies indicate that, under the demand and production conditions assumed, the future agricultural production demands until the year 2000 can be filled at less cost through other developments, such as drainage and flood protection.

Where the soil and water resources are suitable for irrigation, individual operations may irrigate due to the potential profits from this type of management. It is estimated that, in addition to the present 13,800 acres now irrigated, an additional

8,200 acres will be irrigated by 1980 and about 29,000 acres additional by 2020. This will require about 22,000 and 42,000 acre-feet of irrigation water during the driest years. Table 37 and figure 74 indicate the historical and projected water requirements for average and drought years.

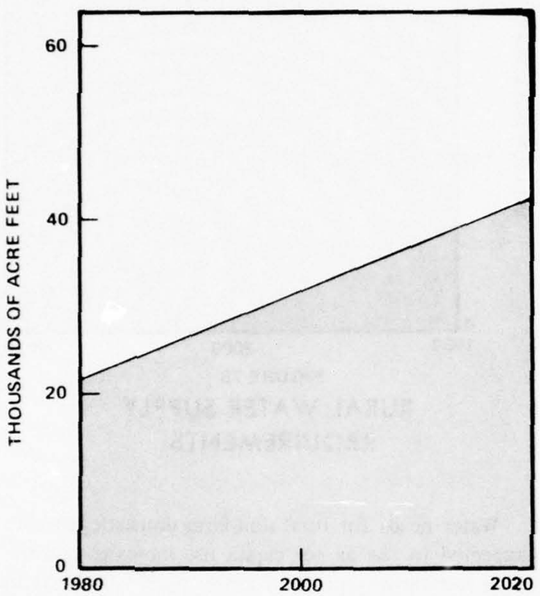


FIGURE 74

IRRIGATION REQUIREMENTS

In the mineral industry, projected water usage by individual numeral industries was estimated on the basis of water requirements per ton of mined or processed product. Data from the 1962 Bureau of Mines mineral industry water canvass were used to determine the water ratios by statistical area for coal, crushed and dimension stone, and sand and gravel. These water ratios were then applied to the estimated mineral production to derive water use in each mineral industry for each year in each area.

One of the problem areas in projected water usage for the mineral industries in the coal sector. The consumer requirements for lower sulfur content can be met by increased water for cleaning. However, coal cleaning plants are expensive and present day technology permits designing utility plants to burn raw coal of specific ash and sulfur contents, a factor which lessens water requirements. In the coal projections of this comprehensive study, compensation is made for a declining incidence of washed coal from 1970 to 2020. Estimates of water requirements in the petroleum industry were limited to use in drilling. A relationship between production and footage drilled per year was derived and applied to the estimated petroleum production to obtain water requirements for the various years.

The water needs for the mineral industry are included along the other municipal and industrial water needs; however, table 38 shows the individual needs for the various elements of the mineral industry; these are illustrated in figure 76.

TABLE 38

WATER SUPPLY REQUIREMENTS FOR THE MINERAL INDUSTRY
(Millions of Gallons)

Commodity	Intake	Discharged	Recircu-lated	Consumed
		1960		
Coal	92	87	230	5
Crushed Stone	407	391	30	16
Sand and Gravel	1,597	1,558	4,212	39
Petroleum	1/	–	–	1/
TOTAL	2,096	2,036	4,472	60
		1980		
Coal	282	256	2,051	26
Crushed Stone	922	884	551	38
Sand and Gravel	3,249	3,172	8,578	77
Petroleum	1/	–	–	1/
TOTAL	4,453	4,312	11,180	141
		2000		
Coal	500	440	4,400	50
Crushed Stone	1,584	1,520	1,744	64
Sand and Gravel	6,214	6,040	16,415	174
Petroleum	1/	–	–	1/
TOTAL	8,298	8,000	22,559	288
		2020		
Coal	325	300	3,000	35
Crushed Stone	2,716	2,582	2,986	134
Sand and Gravel	12,023	11,638	31,787	385
Petroleum	1/	–	–	1/
TOTAL	15,064	14,520	37,773	554

1/ Less than one million gallons.

FIGURE 75. IRRIGATION PROVIDES AN ADDITIONAL DEVELOPMENT OPPORTUNITY IN AREAS OF THE BASIN ENDOWED WITH AMPLE WATER SUPPLY AND SUITABLE SOILS

TABLE 37

GROSS IRRIGATION REQUIREMENTS
(Acre-feet)

Economic Subarea	Estimated Present Use Average Year	Estimated Present Use Driest Year	1980 Average Year	1980 Driest Year	2020 Average Year	2020 Driest Year
1	1,900	3,200	3,150	5,350	6,050	10,400
2	900	1,515	1,500	2,550	2,760	4,750
3	900	1,500	1,350	2,300	3,000	5,200
4	1,750	3,000	2,700	4,600	4,300	7,300
5	950	1,600	1,400	2,450	2,800	4,800
6	1,750	2,965	2,800	4,800	5,900	10,100
TOTAL	**8,150**	**13,780**	**12,900**	**22,050**	**24,810**	**42,550**

NOTE: Water requirements for each projection year are gross estimates which are based on 75 percent application efficiency. Does not include storage or abnormal transmission losses.

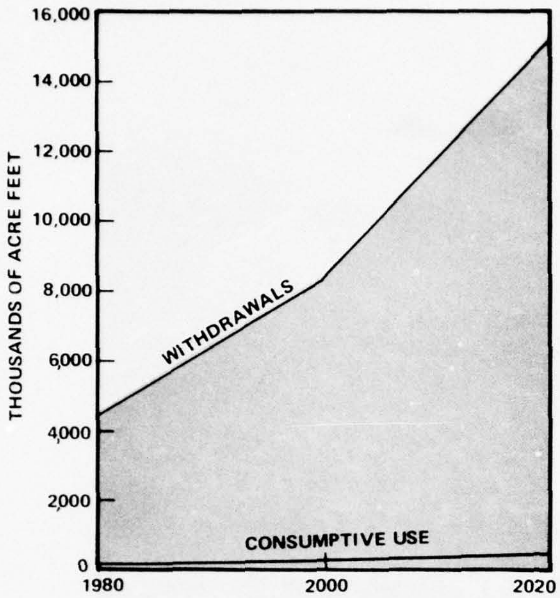


FIGURE 76

MINERAL INDUSTRIES WATER SUPPLY REQUIREMENTS 1/

1/ QUANTITIES INCLUDED IN MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS.

ELECTRIC POWER

The amount of water used for electric generation and its relative impact on other water uses is directly related to the magnitude and characteristics of power generation requirements and resource availability. The areal distribution of use and costs of alternate sources of supply are primarily functions of type and location of power generation sources of supply. Water used in the production of electric power involves the withdrawal and consumption use of large quantities of water for cooling processes in fossil-fuel and nuclear-fired steam plants, or in-stream use by hydroelectric plants involving principally the regulation of flow through available hydraulic head.

Increased electric power load growth throughout the basin can naturally be expected to accompany population growth and economic expansion, but the Basin's electric utility industry has historically exceeded these growth rates. Progressively higher standards of living will also expand the future market. The bulk of the Basin's power supply is produced in steam-electric plants where water is a major factor of production. A relatively small amount of power is produced by hydroelectric or internal combustion methods. The steam-electric plants require relatively small amounts of extremely pure water for boiler use and larger amounts of untreated water for condenser cooling purposes.

The Wabash River Basin Power Region, consisting of 97 utilities located either partially or totally within the basin, is currently an importer of electric energy, and it is expected that the overall region will continue to import during the period covered by this study. In 1965 24 percent of the Power Regions energy requirement was supplied by import. Future imports are projected to amount to 40 percent in 1980, 14 percent in 2000 and 6 percent in 2020.

Based on the past and present development of the Power Region, it appears that for at least the next several decades major concentrations of electric generation within the region will continue to be confined to the Middle Wabash and the West Fork White River subregions. In addition, because of the availability of coal in these subregions, fossil fueled generation should continue to comprise the primary type of generation within the Power Region.

As the economy and population continue to grow, so will the areas of major electric load concentrations. In the future, areas which are today too small to justify major "large unit" construction will become capable of sustaining such developments. As a result of this growth, it is expected that by the year 2000 the Lafayette area will have grown to a size capable of supporting a major generating center.

Also by the year 2000 the growth of scattered loads along the western and southern edges of the Power Region coupled with the growing needs for an adequate supply of condenser cooling water may result in the development of a fourth, though smaller, generating center within the Lower Wabash River subregion. The general pattern, consisting of three primary generating centers, in the Upper Wabash, Middle Wabash and the West Fork White River subregions, along with a smaller qenerating center in the Lower Wabash subregion, is expected to continue through the year 2020.

Existing and projected power requirements, composition of region generation and imports are

presented in table 39, while the power generation demand for water and consumptive use are shown in figure 77.

TABLE 39

ELECTRIC POWER REQUIREMENTS
WABASH POWER REGION

Energy (Million KWH)	Peak (Thousand KW)	Load Factor 1/ (%)	Average Annual Energy Growth Rate (%)
	1965		
17,613	3,283	61.2	—
	1980		
47,886	8,963	60.8	6.9
	2000		
162,149	29,624	62.3	6.3
	2020		
406,466	73,700	62.8	4.7

1/ Load factor (percent) = $\frac{\text{Energy} \times 100}{\text{Peak} \times \text{No of Hours in a Year}}$

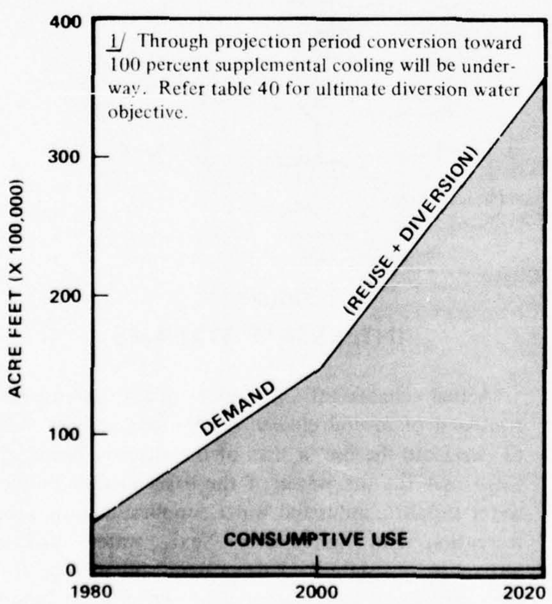


FIGURE 77

ELECTRIC POWER GENERATION 1/
WATER REQUIREMENTS

Cooling water requirements to be met in each of the subbasins through 2020 were determined on the basis of projected generation capacity and composition of the generating systems to be used. These requirements involve a number of aspects including plant efficiency, generator efficiency, heat losses, and other load and heat factors; the combination of these factors in a proper calculation determines the precise cooling water required. Table 40 gives the resulting water required, consumptive losses by types of generation and cooling for the Power Region during the period of study. As a matter of information, steam-electric plants, as a rule of thumb, require one cubic foot of water per second for each one thousand kilowatts of installed plant capacity for cooling purposes. Nuclear plants currently require about 40 percent more water, but it is anticipated that the future amount of waste heat dissipated by these plants will be substantially reduced resulting in a proportionate decrease in water use.

TABLE 40

ELECTRIC POWER
WATER SUPPLY REQUIREMENTS
BY CATEGORY

Year	Cooling Water	Diversion (1,000 Acre-feet)	Consumptive Use
1965	1,877	1,103	18
1980	3,008	573	34
2000	14,131	419	172
2020	35,238	435	435

WATER QUALITY

General

During the course of time, organisms that have been better fitted to live under existing environmental conditions are the ones which survived. Time in geologic terms has been a slow process, and biota developed which were adapted not only to the physical and chemical but also the intrinsic biological factors of the environment. Man has now attained the ability to impose rapid change to his environment and that of other living things. In our society, the transport and dilution of municipal, industrial and agricultural wastes is an important and necessary use of water. Now, in this use, it is essential that water quality requirements recognize that there are not only acute and chronic toxic levels but also tolerable, favorable and essential levels of dissolved materials.

Rivers have always had to carry and purify wastes that enter them from the land. This natural waste -- assimilation capability is limited, variable and dependent upon many factors. However, it is one of their functions in the scheme of things, and so well have they performed it through the years that we have virtually taken it for granted. Within limits, the ability of running water to handle wastes is phenomenal; in earlier times those normal limits were seldom exceeded.

In the Wabash Basin today, as in other river basins throughout the country, there are now more people and industries generating excessive wastes which enter the streams at concentrated points, and exceed the self-purification capacity. As rivers go, the Wabash is somewhat fortunate. It is polluted near most of the urban areas, but many parts of it are free from clusters of population; anyone who travels up and down the river and its tributaries finds many miles of pleasant flowing streams capable of supporting aquatic environment and wildlife. In the paragraphs of this section, the Basin's problems and needs involving water quality will be identified within a framework of standards for all purposes -- municipal and industrial water supply, recreational use, and fish and other aquatic life.

Water Quality Standards

In order to establish the water quality control requirements and needs, water quality objectives had to be established. These objectives had to include satisfactory standards of stream quality for all purposes. One of the provisions of the Water Quality Act of 1965, Public Law 89-234, required the establishment of water quality standards for interstate waters. The Federal legislation encouraged the States to establish standards for the interstate streams in their own jurisdictions, and indicated that in the absence of State action the Secretary of the Interior would adopt such standards. The three Wabash Basin states -- Illinois, Indiana and Ohio -- have set standards not only for interstate waters but intrastate waters as well. It is the intent of the water quality standards to provide the Federal Government, States and local agencies with additional tools for objective and clear public policy on the use of interstate waters. It is for note that interstate waters are defined by the Act to mean all rivers, creeks, lakes or other waters that flow across or form a part of state boundaries, intrastate waters are all rivers, streams, and lakes that are totally within the boundaries of an individual state.

In the Wabash Basin, the streams classified as interstate are listed in table 41 and illustrated in figure 78.

TABLE 41

INTERSTATE STREAMS AND STATES INVOLVED

Stream	States
Wabash River	Illinois, Indiana, Ohio
Clear Creek	Illinois, Indiana
Sugar Creek	Illinois, Indiana
Brouilletts Creek	Illinois, Indiana
LittleVermilion River	Illinois, Indiana
Vermilion River	Illinois, Indiana
Mississinewa River	Indiana, Ohio

FIGURE 78

INTERSTATE STREAMS

Actual enactment of water quality standards consisted of several elements. The first activity was to designate the use or uses of the streams. Some of these uses for the water of the basin include public water supplies, industrial water supplies, aquatic life, recreation and agriculture. Next, water quality criteria were established to protect and provide for the specified water uses. The criteria included numerical values for quality parameters where values were available and applicable, biological parameters and general descriptions of quality desired. A third

portion of the standards was to develop an implementation plan for compliance, describing the corrective measures required and a timetable for achievement of the actions. Finally, the standards enumerated the improvement actions which would be taken if necessary. The standards are presented on table 42.

Municipal Wastewater Treatment Problems

Wastes from municipalities and industries that are discharged to surface waters are generally amenable to some form of treatment. Table 43 shows historical and projected gross municipal wastes loads in the basin. Although this is simply an estimate, it does provide for an assessment of the relative waste loads among the subbasins. The estimate was derived on the assumption that the proportion of population served by organized municipal waste handling systems will increase over the projected period so that by 1977 the urban population will be completely served by sewers.

TABLE 42

OUTLINE WATER QUALITY CRITERIA ADOPTED BY BASIN STATES

Ohio	Indiana	Illinois Interstate	Illinois Intrastate
Public Water Supply	**Public Water Supply and Food Processing Industry**		
Bacteria Threshold-odor Number Dissolved Solids Radioactive Substances Chemical Constituents	Bacteria Threshold-odor Number Dissolved Solids Radioactive Substances Chemical Constituents	Bacteria Dissolved Solids Radioactive Substances Chemical Constituents	Bacteria Dissolved Solids Radioactive Substances Chemical Constituents
Industrial Water Supply			
Dissolved Oxygen pH Temperature Dissolved Solids	Dissolved Oxygen pH Temperature Dissolved Solids	Dissolved Oxygen pH Temperature Dissolved Solids	No Designated Standard
Aquatic Life – Evaluate Conditions for Well Balanced Warm Water Fish Population			
Dissolved Oxygen pH Temperature Toxic Substances	Dissolves Oxygen pH Temperature Toxic Substances Taste and Odor Cold Water Species	Dissolved Oxygen pH Temperature Toxic Substances Taste and Odor	Dissolved Oxygen pH Temperature Toxic Substances
Aquatic Life – Evaluate Conditions for the Maintenance of Biological Growth and for Permitting Passage of Fish			
Dissolved Oxygen pH Temperature Toxic Substances	No Comparable Standard	No Comparable Standard	No Comparable Standard
Recreation			
Bacteria Content	Fecal Coliform Content a. Whole Body Contact b. Partial Body Contact	Primary Contact Secondary Contact	Primary Contact Secondary Contact
Agriculture and Stock Water			
Standards Same as Minimum Conditions	Standards Same as Minimum Conditions	No Specific Standards	Standards Similar to Minimum Conditions

TABLE 43

HISTORICAL AND PROJECTED MUNICIPAL WASTE WATER FLOW

Problem Area	Average Waste Flow (CFS)			
	1970	1980	2000	2020
PATOKA SUBBASIN				
Jasper	2.4	4.0	6.8	10.2
Huntingburg	0.83	1.5	2.5	3.6
Princeton	1.9	2.8	5.1	7.4
EAST FORK SUBBASIN				
New Castle	6.3	7.7	13.0	21.0
Greenfield	2.0	3.2	5.4	8.4
Shelbyville Area		13.0		39.0
Whiteland - New Whiteland	0.7	1.4	2.6	3.7
Franklin	2.2	3.0	5.1	9.2
Rushville	1.0	1.1	2.2	3.1
Columbus	8.7	15.0	30.0	46.0
Greensburg	1.5	2.0	3.6	5.7
Mitchell	0.6	1.0	2.0	3.0
Bloomington	6.8	11.0	17.0	24.0
Vernon - North Vernon	1.3	1.7	3.2	5.7
Austin-Scottsburg	4.0	4.4	5.8	8.9
Paoli	0.50	0.87	1.9	2.8
West Baden - French Lick	0.67	0.84	1.3	1.9
Loogootee	0.38	1.0	2.6	4.5
WEST FORK SUBBASIN				
Winchester	1.0	2.5	5.3	8.3
Muncie		27.0		72.0
Anderson		30.0		69.0
Alexandria	1.7	2.4	4.2	6.1
Elwood	2.7	4.3	7.2	9.9
Tipton	0.9	1.3	2.4	3.2
Pendleton	1.3	1.5	1.9	2.1
Indianapolis		210.0	290.0	420.0
Brownsburg	0.6	0.8	2.1	3.9
Plainfield	1.1	1.5	3.2	5.2
Danville	0.6	0.8	1.6	2.8
Mooresville	0.6	0.7	1.1	1.8
Greencastle	3.1	5.1	11.0	16.0
Brazil	0.9	1.5	3.2	4.2
Linton	1.0	1.1	1.9	2.9
Bicknell	0.5	0.7	1.5	2.0
Washington	2.2	3.0	5.2	7.2
Petersburg	0.3	0.4	0.9	1.3
Bloomington (Plant No. 2)	3.1	7.1	17.0	24.0
UPPER WABASH SUBBASIN				
Celina	1.3	2.2	4.2	6.0
Coldwater	0.8	0.84	1.0	1.4
Bluffton	2.5	3.1	5.0	7.6
Huntington	3.5	5.8	15.0	24.0
Portland	2.9	3.9	6.2	9.3

TABLE 43

HISTORICAL AND PROJECTED MUNICIPAL WASTE WATER FLOW (CONTINUED)

Problem Area	Waste Water Flow (CFS) 1970	1980	2000	2020
	UPPER WABASH SUBBASIN (CONTINUED)			
Montpelier	0.31	0.50	0.87	1.5
Wabash-Lagro	5.7	7.8	12.0	20.0
Union City	1.4	1.7	4.1	7.4
Dunkirk	0.89	1.1	2.1	2.8
Hartford City	3.9	5.6	9.6	15.0
Jonesboro - Gas City - Fairmont	1.8	3.2	5.9	7.7
Marion	11.0	16.0	30.0	45.0
Peru	3.1	4.0	6.8	11.0
Grissom AFB	1.2	1.2	1.2	1.2
Columbia City	1.0	1.5	3.2	5.0
Warsaw - Winona Lake	4.1	5.7	9.5	15.0
Kokomo	20.0	25.0	40.0	62.0
Frankfort	3.8	4.8	7.5	12.0
Lafayette - West Lafayette	33.0	41.0	66.0	105.0
	MIDDLE WABASH SUBBASIN			
Paxton	0.7	1.0	1.5	1.7
Rantoul-Chanute	3.8	4.2	5.3	6.1
Urbana-Champaign	13.7	17.2	23.6	29.8
Hoopeston	3.3	4.3	6.3	8.9
Danville	15.7	20.3	32.5	54.0
Georgetown	1.1	1.3	2.0	3.1
Lebanon	0.9	1.1	2.8	4.2
Crawfordsville	3.2	4.8	8.0	13.4
Rockville	0.4	0.7	1.6	2.2
Terre Haute	40.2	53.2	96.2	156.6
Paris	2.5	3.0	5.0	9.1
Marshall	1.5	2.5	4.8	8.9
Robinson	6.5	6.7	9.8	15.7
Sullivan	0.7	1.1	2.0	2.2
	EMBARRAS SUBBASIN			
Tuscola	0.5	0.8	1.3	1.8
Charleston	1.7	2.3	4.0	5.5
Mattoon	3.1	3.6	6.6	10.0
Newton	0.4	0.7	1.4	1.9
	LITTLE WABASH SUBBASIN			
Effingham	1.8	2.5	4.4	6.3
Flora	0.6	1.2	2.8	4.3
Olney	2.0	2.4	4.4	7.5
Fairfield	1.2	1.7	3.4	6.3
Albion	0.2	0.4	1.0	1.6
Carmi	1.1	1.5	2.5	3.4
Wayne City Area	0.09	0.1	0.2	0.3
	LOWER WABASH SUBBASIN			

Problem areas included in other subbasins.

Essentially effluents from municipal treatment plants must be of such quality that established criteria for the receiving stream will not be violated. At the present time, most municipal wastewater effluents in the basin have an inseparable component; the principal problems with respect to meeting stream standards lie with large organic loadings and a large number of micro-organisms. Nevertheless, 107 small, incorporated communities in the Wabash River basin, which have public water systems, do not have recognized sewer systems. An additional 53 have sewers but no waste treatment plant. Of those treating sanitary sewage, 22 provide only primary treatment, and 96 of the secondary treatment plants do not provide for efficient chlorination.

Two hundred sixty-one municipal sewer systems have been identified in the basin, including those without treatment plants. Not included in that number are the hundreds of small, semi-public, commercial establishments, mobile home courts, and small institutions. Distribution by subbasin is shown in table 44. In addition to building additional sewage systems and improving present systems so as to provide a minimum of secondary treatment plans efficient disinfection, 112 communities are projected to require advanced waste treatment or an acceptable alternative by 1980. Sixty-five others may need treatment beyond the secondary stage during the projection period. An indication of the number of communities in the basin, where advanced waste treatment will be needed, may be obtained from table 45.

Another common shortcoming among the sewage systems in the Wabash Basin is the use of combined storm-sanitary sewers by about 67 percent of the sewered communities. Most of the larger communities use combined sewers; the number of combined sewer systems, by subbasin is presented in table 46.

TABLE 45

COMMUNITIES PROJECTED TO NEED ADVANCED WASTE TREATMENT OR EFFECTIVE ALTERNATIVE BEFORE 2020

Subbasin	Early Action (1980)	Long Range (2020)	Total
Patoka River	3	2	5
East Fork White River	18	9	27
West Fork White River	28	15	43
Upper Wabash River	17	24	41
Middle Wabash River	17	14	31
Embarras River	14	0	14
Little Wabash River	15	0	15
Lower Wabash River	0	1	1
TOTALS	**112**	**65**	**177**

TABLE 46

COMBINED SEWER SYSTEMS

Hydrologic Subbasin	Number of Cities with Combined Systems
Patoka River	0
East Fork White River	27
West Fork White River	33
Upper Wabash River	62
Middle Wabash River	35
Embarras River	9
Little Wabash River	6
Lower Wabash River	1
TOTAL	**173**

TABLE 44
MUNICIPAL SEWERAGE SYSTEMS

Item	Hydrologic Subbasin: Patoka	East Fk White	West Fk White	Upper Wabash	Middle Wabash	Embarras	Little Wabash	Lower Wabash	Basin Total
Number of communities without recognized sewer systems	0	2	25	7	37	18	13	5	107
Number of communities having sewers bur no treatment	1	7	9	20	16	0	0	0	53
Number of communities providing only primary treatment	0	3	5	4	7	0	0	3	22
Number of communities providing secondary treatment but no effluent disinfection	4	13	19	8	21	14	16	1	96
Total number of municipal sewer systems in basin	6	39	54	74	48	18	16	5	261

Phosphorous in Municipal Wastewaters

Conventional waste treatment plants remove about a quarter of the nitrogen and one-fifth of the phosphorous in municipal wastewaters. Both compounds, nitrates and phosphates, are nutrients which fuel aquatic plant growth and hasten entraphication of lakes and reservoirs and indirectly cause extra loads on demands for dissolved oxygen in streams. Of the two control of phosphate appears to hold more promise in enhancing stream quality than control of nitrogen. In order to protect present and planned lakes and reservoirs in the Wabash Basin, a need for at least 80 percent phosphorous removal has been identified for 41 communities in the basin, with or without other forms of advanced waste treatment or flow augmentation, as shown in table 47. Much of the phosphate from municipal sources stems from detergents. If phosphate-bearing detergents are curtailed, much of the cost of phosphorous-removal facilities for some of these 41 communities could be eliminated.

Thermal Pollution

The electric power industry, nationwide, adds about 4/5 of the waste heat passed off to our rivers and streams. In the Wabash River in 1969, 13 out of 25 steam-electric generating plants used once-through cooling, and 10 of these had enough installed capacity that State temperature standards in the streams to which they discharged could be violated during times of low stream flow.

The Federal Power Commission, see Appendix K – Power, has determined that supplemental-type cooling devices will be necessary at nearly all thermal power plants by 2000 and that the changeover will be well along by 1980. On this basis, the greatest amounts of waste heat are being added to the Basin's waters at the present time.

TABLE 47

COMMUNITIES NEEDING ADDITIONAL PHOSPHORUS REMOVAL

Hydrologic Subbasin	Number of Communities
Patoka River	0
East Fork White River	5
West Fork White River	7
Upper Wabash River	20
Middle Wabash River	5
Embarras River	3
Little Wabash River	1
Lower Wabash River	0
TOTAL	41

FIGURE 79. THERMAL POLLUTION

Heavy Metals

Heavy metals are toxic to aquatic life in small quantities and can be toxic in a water supply system. In a limited sampling program, heavy metals in amounts great enough to cause concern were observed in water quality samples at points downstream from New Castle, Greensburg, Indianapolis, Kokomo, Marion and Princeton, Indiana; Coldwater, Ohio; and Mt. Carmel, Illinois.

Due to their toxicity, the only reasonable method of heavy metal pollution is at the source. This control will require specific monitoring devices, sewer-use ordinances and industrial wastewater effluent standards.

Pesticides

Insecticides, fungicides, rodenticides, and herbicides, as a group include both organic and inorganic compounds, all of which can directly or indirectly have a bearing upon the waters in which they are found. The effects of some of these can be detrimental to crops, livestock, wildlife and man himself. Some are easily broken down and disappear quickly while others are persistent. Some are only sparingly soluble in water, but all cause problems if spillage produces high concentrations in water or if they become absorbed on colloidal particles subsequently dispersed in water. Water samples are periodically collected at various points in the basin and analyzed for pesticides. Currently, evidence is lacking that overuse of pesticides has been significant in the basin. Pesticides, principally Dieldrin —— a synthetic hydrocarbon which is quite persistent in the environment, have been detected at the two principal collecting stations--Lafayette and New Harmony, Indiana, on the main stem of the river.

Mining Wastes

As has been indicated in previous sections, the principal mineral resources of the Wabash River basin are coal, petroleum, natural gas, sand, gravel, clay, shale, stone and gypsum. Coal and petroleum production present the industry's most serious pollution problems.

Surface and underground mining for coal has taken place over the last century along a broad band from Pike County, Indiana, generally northward to Danville, Illinois. This band includes parts of the Patoka River, White River, Middle Wabash, and Lower Wabash subbasins. Severe mine drainage pollution exists among the abandoned mines in the South Fork Patoka River watershed and in the Busseron Creek watershed in the Middle Wabash River subbasin. Less severe, but still serious, problems exist elsewhere along the band, usually in areas that have been mined out and have been abandoned without recourse to modern reclamation methods.

FIGURE 80. SURFACE MINING OPERATIONS IN SOUTHERN PORTION OF BASIN

This area, in the South Fork Patoka River and the Busseron Creek watersheds, constitutes the worst of the problem, embracing about 6,000 acres. An initial program to reclaim these areas would cost on the order of $10,000,000. It is estimated that a program to reclaim all the abandoned mines in the basin would cost more than $50,000,000, including grading, fertilizing, planting, investigations, engineering design and special treatments. A continuing reclamation program and enforcement of present laws will be necessary to eliminate the mine drainage problem. Indiana and Illinois regulate surface mining through permits which specify reclamation measures. However, neither State has a state-financed program for reclamation of stripped-over lands, and in view of the present problems a program appears necessary.

Oil and Gas Wastes

In the past, surface wastes of minerals and resulting pollution of water resources were caused by unrestricted and uncontrolled flows of oil, gas, and salt water, which frequently accompanies the production of oil and gas. Many years ago, before modern drilling methods, tools, and safety equipment existed, the wild and uncontrolled flow of gusher wells was not uncommon. Gas wells blew out from time to time, and large volumes of gas were lost before wells could be brought under control. Advances in the technology have done much to prevent surface wastes of oil in blow-outs of gas wells.

In the Wabash Basin petroleum is produced in substantial quantities in six of the eight hydrologic subbasins. The Indiana-Illinois oil fields are declining in production, producing proportionately more brine and less oil. As was indicated above, the existence of the Basin's fields antedates effective regulations for plugging and sealing abandoned wells and dry holes. Secondary recovery operations, such as water flooding and repressuring, sometimes forced brines and oil into potable aquifers and ground water supplies and increased chloride contents of the streams draining the fields. Oil spills and seeps from brine pits, at times, cause severe local problems.

More insidious is the brine pollution of potable ground water. The Federal Water Quality Administration's sampling program reveals a chloride load in surface waters originating in the oil fields. Concentrations have been higher than normal at low flows indicating the possibility of brine pollution in the ground waters feeding the low flows of the streams. It was beyond the scope of the study to sample ground waters extensively, and the gravity of the problem was not clearly defined. These findings give emphasis to the fact that this area of possible ground water pollution is in need of intensive future studies.

Agricultural Wastes

Farming, with over a $1,000,000,000 annual income, is the largest single economic activity in the Wabash River basin. About 65 percent of the land in the basin is cropland, 10 percent is pasture land, 15 percent is forest land, 5 percent is in farmsteads and other miscellaneous uses, and the remaining 5 percent is in urban and built-up areas. Agricultural operations produce three general classes of water pollutants –– sediment, nutrients, and pesticides.

Concerning sedimentation, about 37 percent of the Wabash River basin has erosion problems, ranging from 6 to 90 percent of the land area in individual counties. In addition to adversely affecting turbidity in suspended solids content of the receiving waters, soil eroded from croplands forms a mechanism for transport of fertilizer, principally phosphorous, into streams. As indicated in Appendix H – Agriculture, conservation practices are needed on about 65 percent of the basin, including areas of infertile overwash, swamps, aggraded channel, and areas of deposition as well as erosion.

Nutrients stem from two major agricultural sources, cultivated fields and animal-raising enterprises with a bulk of the load coming from the cultivated fields where fertilizers are used. The use of commercial fertilizers has been increasing dramatically throughout the basin. Agricultural phosphorous, where investigated, is reaching streams in enough quantities to cause algal blooms in basin streams without assistance from other sources of phosphorous. Nitrate values in excess of 10 miligrams per liter reported as nitrogen –– the limit recommended by the Public Health Service to avoid methemoglobinemia in infants –– are routinely being found in streams in the Middle and Upper Wabash Subbasins. The highest values were found in the Vermillion River basin in Illinois, with concentrations up to 21 miligrams per liter.

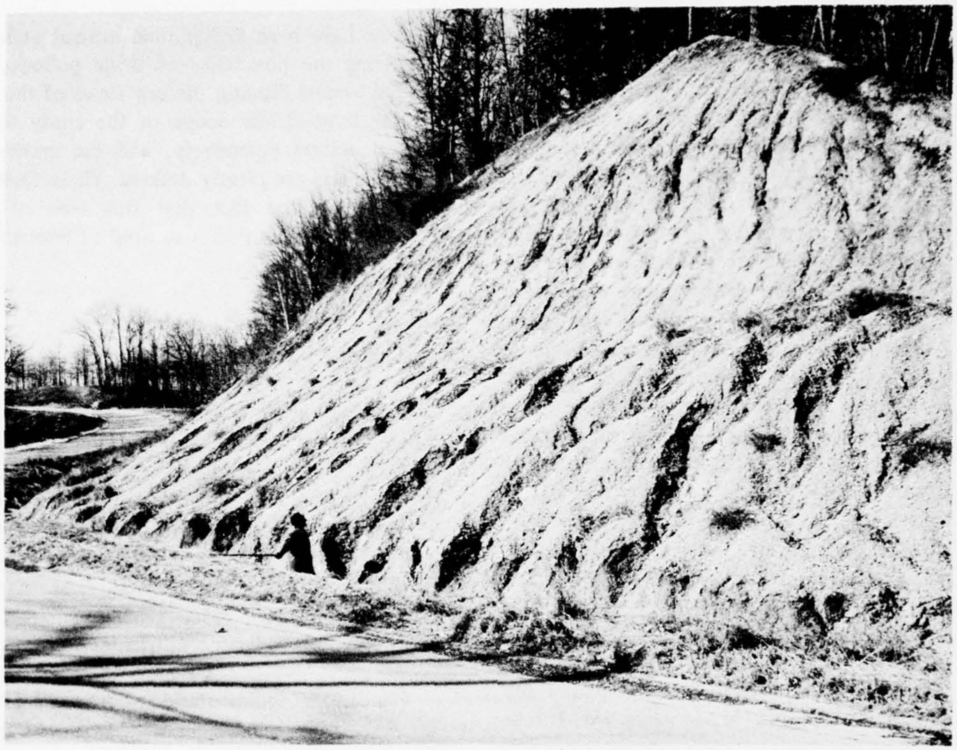


FIGURE 81. BANK EROSION DETRACTS FROM SCENIC BEAUTY AND ADDS TO SEDIMENT PROBLEMS

As stated in the pesticides paragraph, not enough data are available to determine that the existence of an agricultural pesticides problem in the basin, certainly not an extent of severity. However, several of the more persistent synthetic hydrocarbons were detected during . the water sampling program for the study.

Major Soil and Water Conservation Needs

A characteristic behavior of both primitive and modern man has been to seek security, be it social, economic, physical or spiritual. The elimination of insecurity concerning a land area's ability to support itself is the essence of conservation. Land and water are the basic resources. In the inventory for the Wabash Basin studies about 65 percent of the land used for cropland, pasture or woodlands are in need of some conservation treatment. Inventory statistics indicate several things are equally significant. They show the creditable progress that owners and users of the land, with aid of programs and professional advice, have already made in applying conservation practices. At the same time, they show the magnitude of the work to be done.

Susceptibility of the soil to misuse, mistreatment and mismanagement involves one of the most widespread of the Basin's water and land problems. To meet the estimated food and fiber production needs projected to the year 2020, conservation practices will be needed on 13,800,000 acres in order to treat the land according to its needs. This includes cropland, pasture, forest and other rural land such as farmstead, wildlife and idle areas. Of the cropland in the basin, about 14,360,000 are in tillage rotation, 13,000 acres are in orchards, vineyards and bush fruits and 160,000 acres are open land formerly cropped. Of the land in tillage rotation, about 4,400,000 acres are adequately treated or need no treatment. Land treatment needs for cropland are shown in table 48.

Of the 14.1 million acres of cropland, 21.6 percent has a erosion problem currently requiring protective land treatment measures. Such measures are also needed on approximately 856,000 acres or 40 percent of the pasture area and 48,100 acres or 1.4 percent of the forest land. Without adequate land treatment practices, the soil resource will deteriorate resulting in a reduction in the productive

TABLE 48

LAND TREATMENT NEEDS

CROPLAND

Economic Subarea	Crop Residue and Annual Cover	Soil Rotation	Contouring	Strip Cropping, Terraces or Diversions (1,000 Acres)	Use Change	Drainage	Other	Total
1	366.5	129.7	106.8	335.3	123.0	389.8	62.7	1,513.8
2	570.6	284.9	74.4	121.2	60.4	913.2	13.8	2,038.5
3	228.2	161.9	90.1	132.4	50.7	285.6	34.4	983.3
4	576.6	162.3	190.7	204.5	50.5	651.6	2.3	1,838.5
5	337.8	158.6	65.2	65.7	19.0	297.6	9.8	953.7
6	743.9	465.2	136.8	176.3	95.6	1,449.2	23.7	3,060.7

PASTURE AND OTHER LAND

Economic Subarea	Use Change	Grazing Protection	Plant Cover Improvement	Reestablish Vegetative Cover (1,000 Acres)	Brush Control	Total Pasture Needing Treatment	Total Other Land Needing Treatment
1	21.4	46.7	154.5	100.1	75.2	397.9	88.7
2	3.5	42.3	66.7	65.9	87.6	266.0	92.0
3	5.3	17.4	46.1	55.2	26.2	150.2	22.1
4	11.5	21.6	41.4	49.8	46.3	170.6	37.8
5	0.7	21.5	35.3	25.1	49.0	131.6	20.6
6	1.2	45.0	91.9	82.9	52.9	273.9	75.7

NON–FEDERAL FOREST LAND

Economic Subarea	Establish Timber Stand	Improve Timber Stand	Fire	Protection From Insects and Disease (1,000 Acres)	Animals	Erosion	Establish Windbreak and Shelter Belts
1	108.5	536.3	1,223.6	1,223.6	304.5	12.5	1.5
2	40.6	218.6	394.0	394.0	226.7	21.1	0.8
3	40.0	174.3	160.3	36.3	79.0	2.3	0.9
4	67.9	140.6	58.6	36.4	103.6	4.9	1.4
5	21.4	129.4	170.1	170.1	110.0	5.1	3.2
6	17.0	73.3	102.5	102.5	129.8	2.2	2.2

OTHER FOREST LAND

Measures	1980 Hoosier National	1980 Other Federal	1980 State	2000 Hoosier National	2000 Other Federal (Acres)	2000 State	2020 Hoosier National	2020 Other Federal	2020 State
Harvest Cutting	15,600.0	14,635.0	9,375.0	30,400.0	31,675.0	21,175.0	45,200.0	48,615.0	37,200.0
Tree Planting	19,230.0	2,075.0	11,600.0	21,140.0	4,165.0	14,725.0	21,140.0	6,255.0	17,150.0
Timber Stand Improvement	22,783.0	26,885.0	2,590.0	29,000.0	51,685.0	4,810.0	39,000.0	76,945.0	7,125.0
Erosion Control	747.0	2,133.0	—	860.0	2,183.0	—	860.0	2,233.0	—
					(Miles)				
Abandoned Roads	116.0	—	—	132.0	—	—	132.0	—	—
Gully Erosion	19.4	726.0	—	22.5	726.0	—	22.5	726.0	—
Streambank Erosion	10.0	—	—	11.8	—	—	11.8	—	—
Lake Shore Stabilization	0.8	—	—	1.0	—	—	1.0	—	—

FIGURE 82. CONTOUR FARMING IS ONE METHOD OF LAND TREATMENT THAT HAS BEEN APPLIED TO THE BASIN

(Courtesy of U.S. Forest Service)
FIGURE 83. TREE PLANTING IS ANOTHER TYPE OF LAND TREATMENT THAT HAS BEEN USED ON BASIN LANDS

potential on the land. Upland erosion in forest areas is not a significant problem in the basin, as undisturbed or well-managed forest areas normally yield little runoff, even under severe rainfall conditions.

Scouring of the flood plain land is a form of erosion which occurs when floodwaters leave the confines of the stream channel and cause erosion or scouring of localized, broad, shallow channels in low parts of the flood plain. This type land damage is particularly severe in the East and West Forks of the White River subbasins.

Much of the glaciated area, and to some extent areas outside the glaciated area, have soils which were wet in their natural state. Agricultural development of the basin has resulted in installation of some artificial drainage in most of the problem soils. Approximately 36 percent of the cropland is currently drained, 23 percent is potentially drainable and one percent is not drainable. Improved and more efficient agricultural management techniques in recent years have resulted in greater capacity requirements for drainage measures. Consequently, many older drainage installations do not meet current design capacity requirements. This situation, together with a lack of adequate maintenance on some channel measures, has resulted in a recurrence of the drainage problem on much of the area previously drained. Combinations of these conditions result in about 8.5 million acres of land with an excess water problem. Economic studies of the cropland that can be improved by drainage indicate about 79,000 acres of currently undrained land show potential for improved efficiency through drainage by 1980. The projected economic potential for drainage increases to 784,000 acres by 2000 and 2,963,000 acres by 2020.

Unlike the Basin's oil and minerals, the forests are its greatest renewable natural resource. Since the commercial forest land is predominately in small, private ownerships, the basin must continue to depend on this ownership class for the bulk of its forest products. With the population of the region to double by 2020 and the commercial forest area projected to remain stable, protection and management of private forest lands must not only be continued, but their productivity and use must be increased. Practically all of the 3,037 of privately owned commercial forest land is in need of some treatment. Field plots taken throughout the study area indicate that approximately 80 percent of this ownership class is in need of various management practices including planned harvest cutting, stand improvement, plantings and grazing control.

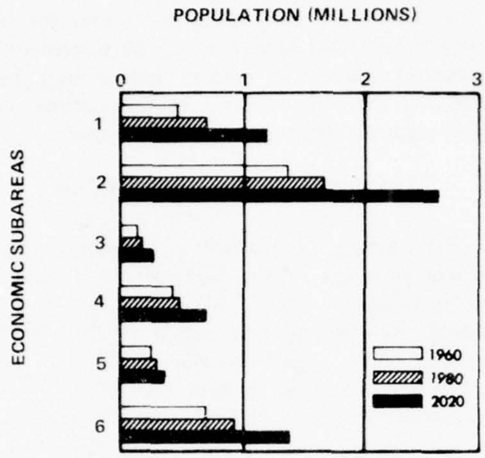
ENVIRONMENTAL RESOURCES

The human environment is composed of the natural resources of the land and water with the modifications of man. For the purposes of establishing the environmental needs in this comprehensive study, problems and needs data were collected for general outdoor recreation, fish and wildlife conservation, regional history, archaeological values and scientific resources. The importance of this knowledge and the fundamentals of conservation is simply: how we handle our environment may determine our future. An environmental approach to water and related land resource development has required a re-examination of many objectives and a basic examination of "conservation". Conservation has been given many formal definitions, but much of our present difficulty in the problems and needs area can be attributed to oversimplification, limited focus and narrowness of scope. For our purposes in the following paragraphs conservation involves the planning and control of man's activities in his environment, considering destiny of the human race and with an attitude of providing environments suitable to the satisfaction of the broadest possible range of man's aspirations.

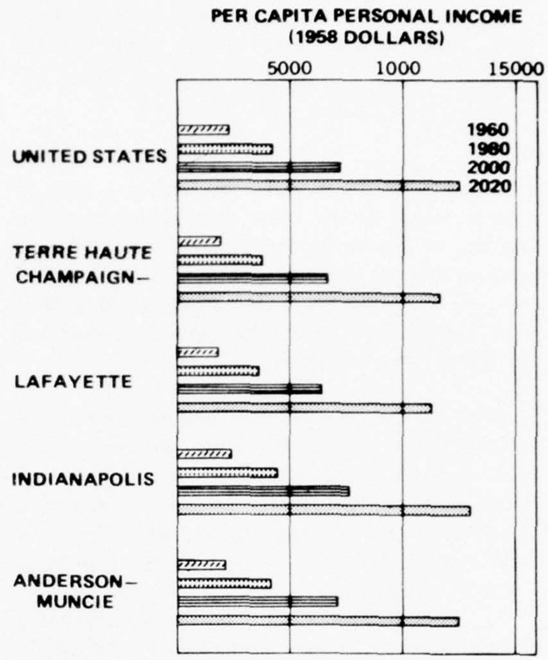
Recreation

Today, recreation experiences are an increasingly important social and economic part of contemporary American life. In support of this fact in the Wabash service area is the increasing number of local, regional and national agencies which provide recreational services. In 1968, approximately 13,700,000 man-days use were recorded on the Basin's 53,380 acres of water and 286,000 acres of recreational land available for public recreation purposes.

In order to develop an indication of the need for additional recreational facilities, projections of demands were made to eight general water-oriented



INCREASING POPULATION



INCREASING PERSONAL INCOME

INCREASING LEISURE TIME

RECREATION TRENDS

FIGURE 84

recreational activities within the six economic subareas. These eight activities were swimming, boating, water skiing, picnicking, camping, sightseeing, nature walks, and hiking. All of the projections of future recreational demand are based on a reasonable assessment of those major factors affecting demand – population, income, mobility, leisure time, urbanization and the aforementioned activities sought.

Concerning these major factors, the Wabash Basin population in 1960 was estimated to be 3,250,000. By 1980 it is expected to reach 4.2 million, and by the year 2020, 5.5 million. In 1960, about 56 percent of the people in the basin lived in urban areas, the remaining 44 percent in areas classified as rural. Six Standard Metropolitan Statistical Areas had a total of 1,574,000 inhabitants, or 48 percent of the 1960 basin population. These urban areas, in order of size are Indianapolis, Terre Haute, Anderson, Muncie, Lafayette-West Lafayette in Indiana and Champaign-Urbana, Illinois. Concentration of growth in metropolitan counties is expected throughout the projection period. Total personal income for the basin is projected to increase from $3,000 in 1960 to $4,500 in 1980, to $7,500 in 2000 and $13,000 by 2020. Figure 84 contains graphical representations of projected increases in population and personal income. The area's interstate highway system, although not complete, has brought increasing numbers of out-of-state tourists into and through the basin, and general mobility is expected to increase by 25 to 35 percent upon completion of the present interstate program. Since the 60-hour work week of 1900, there has been a definite trend to shorter work weeks and longer paid vacations, which means more leisure time. Comprehensive knowledge is generally lacking about recreational activities and the related individual motivations which make some activities more popular than others; the only planning guide is the present activities of users and the characteristics of users.

Considering the foregoing factors the projection of demands for outdoor recreation in the Wabash River basin utilized 1960 recreation participation rates and estimates of future changes in recreation uses as generally presented in the Study Reports of the Outdoor Recreation Resources Review Commission. The methodology may be said to be people-oriented in that the demands within the study area were determined as those demands which are created by the population. Affecting the study area and which could be expected to occur if facilities were made available. The present and projected net outdoor recreation requirements are presented in table 49 for the economic subareas and illustrated for the basin in figure 85. Net requirements were obtained by subtracting the capabilities of the 1965 going program from the projected requirements.

TABLE 49

OUTDOOR RECREATION DEMAND
(Millions of Annual Recreation Days)

Economic Subarea	1968	1980	2000	2020
1	6.4	10.6	20.7	31.5
2	17.7	26.9	48.6	69.2
3	2.1	3.2	6.0	9.2
4	7.2	10.4	17.8	25.8
5	3.9	5.6	9.5	12.9
6	12.9	20.1	36.3	53.0
TOTAL	**50.2**	**76.8**	**138.9**	**201.6**

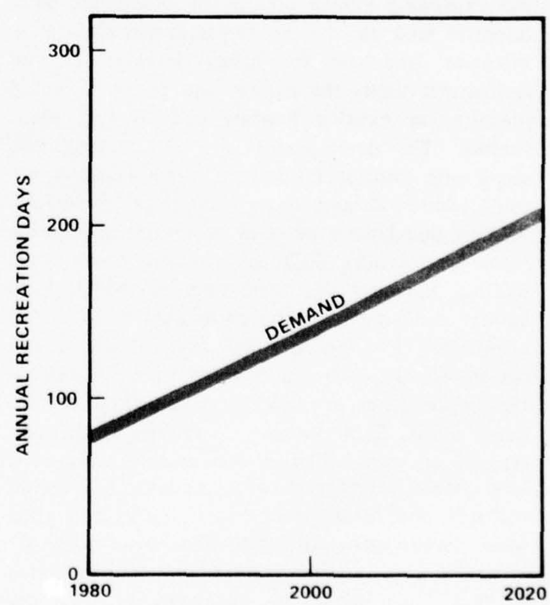


FIGURE 85
OUTDOOR RECREATION REQUIREMENTS

The outdoor recreation demand in the Wabash River basin stems mainly from the metropolitan areas, where there are limited opportunities for satifying these demands. This particular aspect points up just one of the serious imbalances which impair existing recreation facilities and opportunities throughout the Wabash River basin. Where water is plentiful, as along the mainstem of the Wabash, there are few parks and few people. Where public lands are plentiful, as in the southern portion of the basin, there is little water and few people. In Economic Subarea 2, where people abound, there is little water and public lands are not plentiful. This problem of geographical imbalance results largely from our industrial economy, which concentrates people and industry in urban complexes.

Sport Fishing and Hunting

The Basin's water resources have a vital relation to fish and wildlife. Fish species are intimately dependent on the particular characteristics of their water environment. The water areas, wetlands and lands bordering the water areas of the basin are the natural habitat of fish and waterfowl.

Most of the fish and wildlife problems of the basin are directly related to overuse and misuse by our expanding human population and to the more intensive land use that accompanies this expansion. Intensive land use for urban development and agricultural limits the habitat and places increased pressure on existing hunting and fishing opportunities. The development of rural communities, along with associated roads and other facilities, are using additional land at an increasingly rapid rate. Wildlife populations of some of the most desirable game species have declined in recent years while hunting pressures are increasing. A reduction in habitat over much of the basin may be primarily responsible for this decline. One of the major reasons for the decline in fish and wildlife habitat is the urbanization in rural areas and the trend to larger farms. Small farming operations of the past created an ideal situation for wildlife with small crop fields interspersed with pastures, hay fields, orchards and brushy fence rows; coves and food were always close at hand. Now crop fields are becoming larger and fence rows are being eliminated so that some species do not have the necessary variety of habitat conditions available within their normal daily range.

Perhaps the major problem relating to the fisheries of the basin is their location in relation to urban centers of demand. The most populous areas have the least opportunity for lake or stream fishing. Other fishing problems include water pollution and a lack of management of the fisheries.

In essence shorter work weeks, higher pay scales, better communications, faster transportation and high grade fishing equipment combined with the present day changes in the agricultural and urban sectors are contributing to greater hunting and fishing pressures on a decreasing array of species.

Projections of future hunting and sport fishing demands were based on license sales per capita for each subarea, resident fishing licenses as percent of population, percent of population which is rural and acres of ponded water per capita for fishing and acres of potential hunting land per capita for hunting. Estimates of future hunting and sport fishing demands were determined by applying a per capita licensed-resident sales factor to subarea population projections. Details are given in Part 3 of Appendix I – Environmental Resources; projections, reflecting net requirements, are illustrated in figure 86 and summarized in table 50.

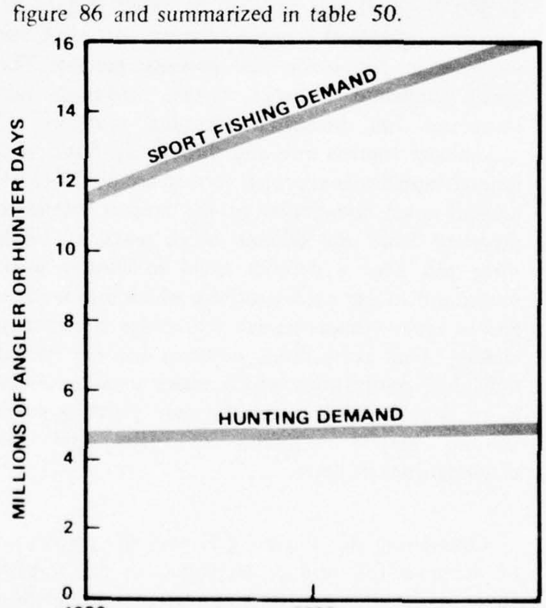


FIGURE 86

SPORT FISHING AND HUNTING REQUIREMENTS

TABLE 50

SPORT FISHING AND HUNTING GROSS AND NET DEMANDS (In Thousands)

Economic Subarea	Time Frame	Total Anglers	Angler-Day Demand Gross	Angler-Day Demand Net	Total Hunters	Hunter Day Demand Gross	Hunter Day Demand Net
1	1968	114.4	2,059.2		56.8	742.2	
	1980	158.2	2,644.2	578.5 1/	79.8	905.5	156.9
	2000	201.1	3,361.8	112.9 1/	102.8	1,051.4	307.3
	2020	234.0	3,910.3	221.5	118.6	1,131.5	394.7
2	1968	205.3	2,438.8		84.7	730.5	
	1980	269.3	2,980.5	401.1 1/	158.1	1,175.2	455.6
	2000	338.9	3,721.5	376.9	172.5	1,083.1	391.9
	2020	383.6	4,203.3	454.5	177.6	943.3	255.0
3	1968	23.4	444.6		17.5	236.7	
	1980	31.5	555.8	523.0 1/	21.0	254.0	17.1
	2000	37.9	663.6	349.2 1/	25.8	280.2	45.7
	2020	41.9	766.0	55.2 1/	30.2	304.3	72.2
4	1968	65.3	1,045.5		40.1	601.0	
	1980	78.9	1,167.9	475.9 1/	55.8	781.0	179.1
	2000	93.3	1,378.0	189.8 1/	64.8	848.0	252.0
	2020	101.2	1,833.1	91.0	72.8	904.9	314.7
5	1968	46.4	788.8		20.7	250.9	
	1980	58.5	922.3	195.6 1/	28.3	328.0	77.7
	2000	64.4	1,016.6	143.3 1/	32.4	354.8	107.2
	2020	69.5	1,097.4	163.0 1/	35.0	373.5	127.3
6	1968	159.9	2,596.0		56.6	518.6	
	1980	211.1	3,176.4	336.9	114.3	983.7	470.7
	2000	257.1	3,860.8	979.3	148.4	1,097.7	599.7
	2020	287.1	4,306.4	1,025.6	156.9	1,131.6	645.2
TOTAL	1968	614.7	9,372.9		276.4	3,079.9	
	1980	807.5	11,447.1	1,837.2 1/	457.3	4,427.4	1,357.1
	2000	992.7	14,002.3	561.0	546.7	4,715.2	1,703.8
	2020	1,117.3	16,116.5	1,574.4	591.1	4,789.1	1,809.1

1/ Denotes an excess.

These subareas where the 2020 hunting and fishing demands are the greatest, Subareas 2 and 6, correspond to the most populus subareas of the West Fork (Indianapolis) and Upper Wabash (Lafayette-West Lafayette, South Bend and Fort Wayne). There are numerous possibilities of meeting these increasing fishing and hunting demands. Projected fishing demands may be satisfied through an aggressive plan of action involving the creation of additional habitat by ponded water, improving existing habitat by improving water quality and providing additional access to fishing water, preservation of existing habitat by reducing physical changes and by improved management to increase both the resource and its utilization.

Projected hunting demands can be met through more intensive management of existing hunting lands, introduction of promising species to increase game population, providing additional public hunting lands, and providing access to more private lands by establishing relations between private land owners and sportsmen.

FIGURE 87. THE WABASH BASIN OFFERS NUMEROUS OPPORTUNITIES FOR FISHING.

Other Environmental Needs

Thus far our efforts of this section have been oriented to general recreation and fish and wildlife recreation, and quite naturally so, as these elements are perhaps the only environmental needs where attempts are made to measure the activities and desires of the people for the determination of resource development and preservation. In Section II are inventories of the Basin's historical, archaeological and natural areas of particular significance was presented; more details on these features are presented in Appendix I – Environmental Resources. It is these areas which have a need for preservation as they, each in their own way, offer natural beauty, cultural value, scientific significance and very often wildlife habitat as well. While the basic need in environmental preservation frequently requires inaction, the needs for recognition and for conforming or disallowing structural measures in these surroundings must not be overlooked. Environmental preservation must be carefully considered in all its aspects in planning for the development of basin potentials.

Therefore, historical preservation for public enjoyment has been the most successful achievement in this area of environmental resources. Private organizations, the States and the Federal Government are caring for and making available some of the more important historic sites of the region. Much more remains to be done, however, in this valley so rich in history. Particular emphasis needs to be placed on sites of archaeological importance – little has been done. Similarly, a program of protecting and interpreting natural landmarks of scientific interests is needed. Historic buildings and townscapes of local and state interest require additional attention.

NAVIGATION

To fully understand the navigation needs picture, it is essential to view the past, present and potential of this mode of transportation in the basin. The next several paragraphs will pursue the subject along these lines.

The needs for navigation have changed with time, dramatically from the settlement era and post Civil War days; modes of transportation have changed and demands for basin resources and products have shifted – today the needs of the bulk transportation are evident for this region which lies at the crossroads of the world's greatest trading nation.

Essentially the stream provided a route north for settlers and an avenue of trade south. First the flatboats, then after about 1823, steamboats transported goods on the river, especially during the spring high water. Packet boats operated upstream as far as Peru, Indiana. Navigation interest grew, and between 1832 and 1853 the State of Indiana constructed over 450 miles of canals. The most extensive canal route of the state system connected the Maumee River at Fort Wayne with the Wabash, left the Wabash at Terre Haute and continued to Evansville by way of the Eel River, White River and Pigeon Creek. The system fell into general disuse with the growth of rail transport and provision of better service. After this initial era of state and private navigation development, the Federal Government showed concern for navigation development in the basin. In 1872 the first report recommending Federal navigation improvement of the Wabash was made and published in the Annual Report of the Chief of Engineers for that year. Subsequently, the Federal Government rebuilt the Grand Rapids Lock and Dam, originally constructed by the Wabash Navigation Company on the Wabash River near Mt. Carmel, built several dams and dikes to control bank erosion and the course of the river, removed snags, and dredged through numerous sand and gravel bars. Appropriations for navigation improvement ceased in 1902, but the lock and dam continued in operation for some time; the Rivers and Harbors Act of 3 March 1925 authorized removal of the dam at Grand Rapids.

At the present time, commercial navigation on the Wabash River is practically nonexistent. However, there are a few remaining ferry boat crossings and some sand-gravel dredging operations of local importance. Practically no development features remain from past improvements; dredged channels, regulatory dikes, dams and other past feastures have been obliterated by time. Rock ledge cuts remain, but these would be of little significance to any future development. In recognition of the navigation past and the present local traffic, the Corps of Engineers requires navigation permits for pertinent development from the mouth to Terre Haute.

During the course of this current comprehensive study, some engineering and economic studies were initiated to determine whether detailed survey scope

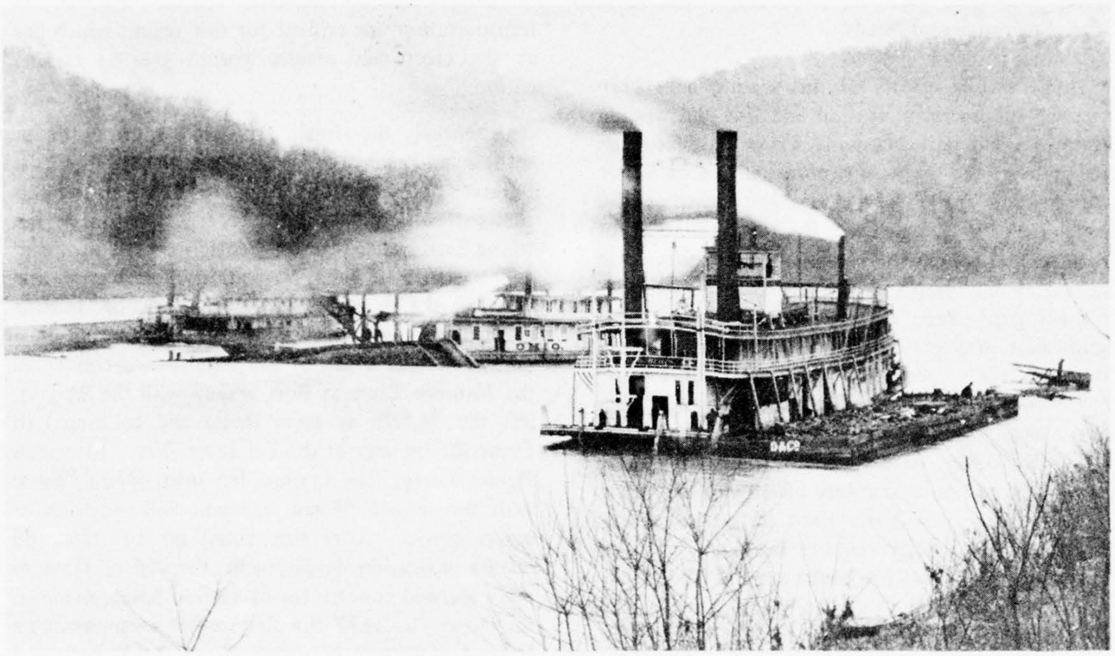


FIGURE 88. NAVIGATION DURING THE SETTLEMENT AND POST CIVIL WAR ERA

FIGURE 89. AN EXAMPLE OF COMMERCIAL NAVIGATION AT THE PRESENT TIME

studies would be warranted. On 6 March 1967, however, a survey scope study, known as the Cross-Wabash Navigation Study, for possible navigation on the Wabash River extending from the Ohio River to the Great Lakes was authorized by the Public Works Committee of the United States Senate. Commodity studies during the aforementioned initial work indicated interest from firms or businesses engaged in producing, manufacturing, processing or otherwise handling the following bulk type commodities: grains and grain products, primary and fabricated metals and metal products, non-metallic minerals, ceramics, tile and concrete products, stone, sand and gravel, industrial chemicals and petroleum products, fertilizer materials, and wood and paper products.

From these indications, the needs for an extensive navigation improvement program on the river or in the river system appear to be varied and have far reaching effects on present and prospective trade. First and most important from the viewpoint of society as a whole are potential reductions in transport costs made possible by an improvement. For many types of commodities – particularly those commonly referred to as "bulk" and having a low value per unit of weight – movement by barge is cheaper than by any alternative transport mode. Large volume movements of bulk commodities have long been a distinguishing characteristic of the traffic on our inland waterway systems. The advantage to the Nation's economy of barge transportation can be measured by the extent which fewer resources are required to perform the transport service than would be required in the absence of the waterway system. For many commodity movements this reduction in a region's freight bulk is considerable.

The difficulties involved in defining and measuring social costs and benefits have led to the measurement of transportation savings to shippers as an estimate of navigation benefits. From the initial field traffic survey conducted in 1965 for this comprehensive study and the current work for the Cross-Wabash Navigation Study, it has been determined that rail shipments constitute the principal means of transporting bulk commodities in the tributary area; some 98 percent of the coal surveyed was shipped by rail. Generally, other commodities shipped long distances, into and out of the tributary area, were transported by rail and the shorter hauls, originating and terminating within or near the tributary area, were made by rail and truck or truck only. Bulk and weight of commodities appeared to be the principal determinants on the mode of transportation used.

Table 51 is a resume of the survey questionnaires in the 1965 commodity study; the questionnaire number, commodity and present mode of transportation are listed.

During the boating season, recreational craft use the rivers and lakes in the Wabash River basin with a wide variety of floating equipment from canoes to luxury yachts. Local political entities, private companies and individuals have built launching, docking and service facilities at a few points on the existing waterway system. Canalization of the mainstem for navigation by the construction of dams and locks creating slack water pools is usually ideal for pleasure boating. The present planning of a navigation system on the Wabash River and its tributaries offers a unique opportunity to recognize the economic needs of our nation and region, and to consider the environmental rate that such an undertaking could play in replenishing the natural grasses and flood plain forest areas to the valley by planned sanctuary areas.

TABLE 51

RESUME OF POTENTIAL WATERWAY TRAFFIC, 1965

Questionnaire Number	Commodity	Annual Net Tons for Screening and Analysis
9	Corn	40,000
	Wheat	10,000
	Soybeans	10,000
10	Steel Pipe	4,000
12	Structural Steel	10,000
32	Pig Iron	3,000
34	Copper and Steel Products	1,000
39	Steel	2,400
46	Triple Phosphate	5,500
	Diamond Phosphate	5,500
	Anhydrons Ammonia	4,000
	Nitrogen Solution	3,000
60	Mineral Tile	3,000
62	Pre-stressed Concrete Beams	4,000
63	Zircon Sand	1,000
65	Steel Products	70,000
	Lime	23,000
66	Raw Steel	5,000
67	Waste Paper	30,000
	Pulp	4,142
69	Sand and Gravel	40,000
87	Finished Bags	25
93	Corn	24,000
	Wheat	4,800
	Soybeans	320
95	Aluminum Coils and Sheets	42,000
96	Anhydrons Ammonia	1,625
	Methanol Alcohol	9,500
98	Steel	240
100	Crushed Stone	10,000
100	Finished Stone	10,000
102	Grain	17,100
103	Building Stone	4,200
114	Steel Rods	14,850
118	Soybean Meal	70,000
	Corn Meal	20,000
	Corn Grits	30,000
121	Limestone	2,500
140	Cylinder Blocks	50,000
	Sand, Special	119,000
	Cast Iron	55,000
	Pig Iron	44,000
	Steel Scrap	86,000
145	Aluminum Rods	100
	Steel Bars and Coils	2,100
151	Coal Tar Pipe Coatings	1,000
154	Pulpboard	5,690
	Pulpwood	24,000
	Chemicals	1,479
	Pulpboard (Kraft)	20,000
	Hardwood Bark Mulch	3,750
	Mosphate Rock	7,500
	Potash	7,500
	Petroleum Products	3,000
	Grain	332,000
159	Asphalt	23,000
65	Coal	48,000
67	Coal	48,700
154	Coal	9,306,900

SECTION VI – FORMULATION OF COMPREHENSIVE BASIN PLAN

INTRODUCTION

In accordance with current planning documents, a principle objective in water resource planning "is to provide the best use, or combination of uses, of water and related land resources to meet all foreseeable in short and long-term needs". To accomplish this in an expanding economy, the comprehensive studies for this report analyze past accomplishments and present and future requirements and compare them with unused or under-used water and related land resources to develop a program for the efficient satisfaction of projected demands.

It was recognized, that the comprehensive studies, to be most effective as guides for an action program and to serve as a sound base for continuing the planning process, should be both broad in coverage and flexible in structure so that additional alternative courses of action may be examined, evaluated, and instituted as desirable or necessary. Formulation of the Wabash River basin plan of development has been accomplished with these planning goals and reported objectives in view.

This section explains the basis for techniques in formulating the comprehensive development program, and it gives the basic facts concerning the past and present status of water and related land resource development and a projected view of future requirements. A development program is formulated to present, by time periods the goals and initial development costs to meet the projected demands of the people in their economic endeavors.

Essentially, the work of this section was the result of integrating the cooperating efforts of the participating agencies. Table 52 lists the cooperating agencies with their assignments and contributions to the planning effort.

PLANNING ENVIRONMENT

Planning Concepts

The planning concepts and process followed is relatively straight-forward in regard to the basic steps involved, yet comprehensive in terms of investigative coverage and details handled. Procedural steps in the overall planning process are shown digrammetrically in figure 91. Stated in simplest terms, implementation of the planning process involves:

a. Determination of the needs for water and related land resources by the present and projected production of goods and requirements for services;

b. Assessment of the effectiveness of available resources in going programs in satisfying the need;

c. Determination of remaining needs for water and related land and assessment of resources availability; and

d. Formulation of the plan of development which would provide a guide for the best use or combination of uses of the available water and land resources in satisfying short and long-term needs.

Elements of the plan with their cost were then delineated by time periods in accord with the goals set in meeting the development needs in the basin.

Key precepts in formulating the comprehensive plan were as follows:

a. The plan would be accomplished on the premise that, as the competition for available resources, laws and management policies would be adopted in the entire basin to implement efficient development and use of the water and related land resources;

b. Budgeting limitations imposed by future availability of funds and the necessity for other programs would not be a constraint on implementing the plan of development identified as being required to meet projected needs.

In summary, the most significant influencing factors affecting formulation for a plan of development for the Wabash River basin are those which have been previously discussed in Sections I through V of this report. Under these broad categories are such factors as topography, for example, which has an important environmental effect on the location and activities of man and the distribution and capacity of the existing major water control structures in the basin. Further discussion of these elements will not be given here, but later the individual subbasins will be examined.

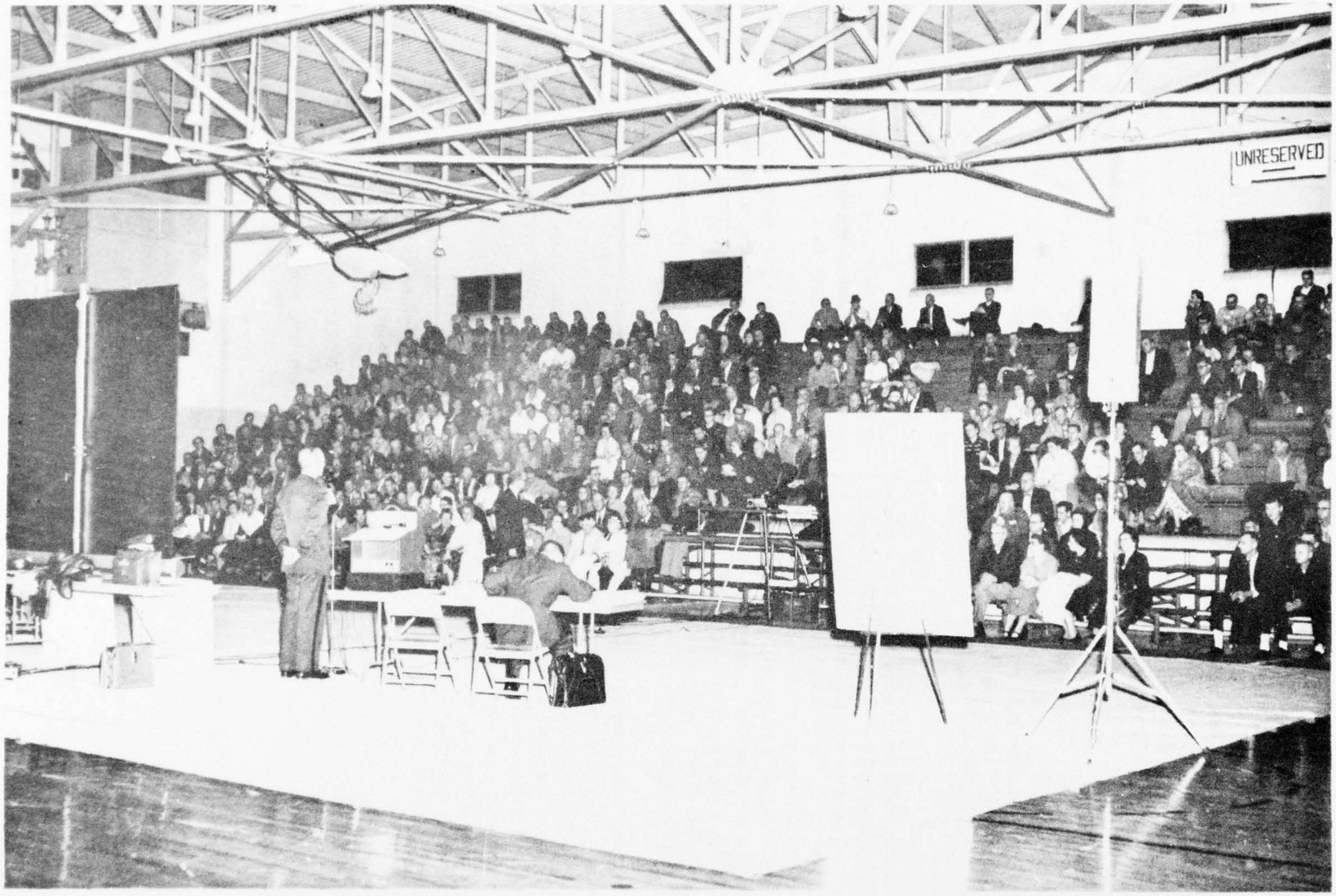


FIGURE 90. PUBLIC MEETINGS WERE AN IMPORTANT AND INTEGRAL PART OF PLAN FORMULATION

TABLE 52

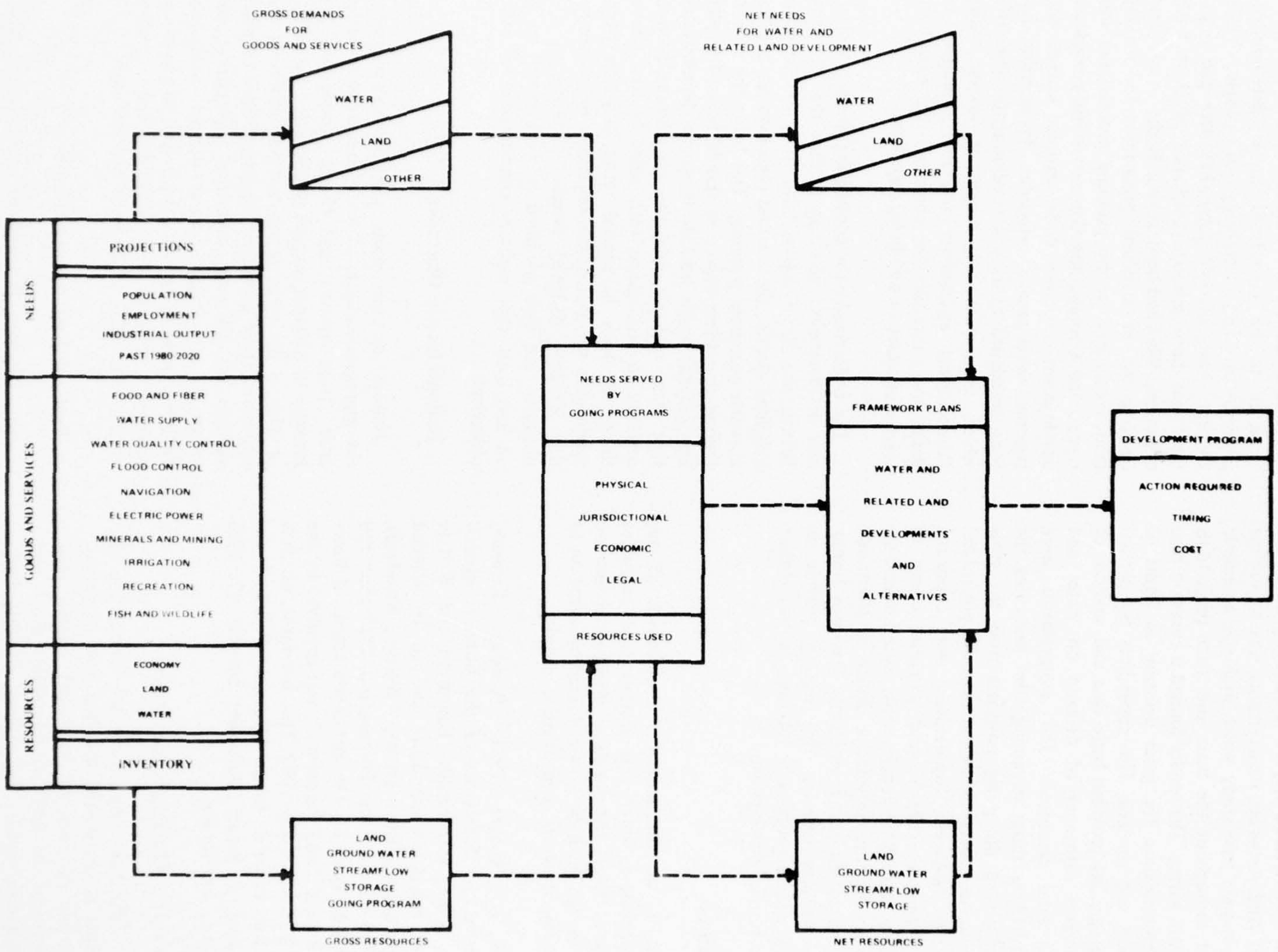
RESUME OF COOPERATING AGENCIES WITH REPORTING ASSIGNMENTS

Cooperating Agency	Assignment	Appendix	Volume Number	Title
Corps of Engineers	The Corps has had the responsibility of coordinating the study, consolidating information from studies of other agencies and processing the Committee report. Studies included the identification of development and conservation needs; identification and evaluation of reservoir sites, local protection projects and other structural features; and the holding of public hearings and meetings pursuant to the comprehensive basin plan.		I	Main Report
		A	II	History of Study
		B	III	Economic Base Study
		C	IV	Plan Formulation
		D	V	Flood Problems and Solutions
		E	VI	Hydrology
		L	XIII	Project Engineering Studies
Department of Agriculture	The Department of Agriculture through the Economic Research Service, Forest Service and Soil Conservation Service, furnished special studies covering the agricultural and forest based economy of the basin, land use, cover, irrigation, rural water supply, sedimentation and upstream watershed control, including land treatment measures and multipurpose structures.	H	IX	Agriculture
Department of Commerce	The Department of Commerce has participated through four agencies including the Office of Business Economics, Census Bureau, Coast and Geodetic Survey, and Environmental Science Service Administration. All were called on to furnish information, which in itself represents decades of invaluable study and service through many continuing programs.			
Department of Health, Education and Welfare	The Department of Health, Education and Welfare through the Public Health Service, conducted a study on the public health aspects of water and related land resource development. The principal health evaluation aspects covered water supply and recreation.			
Department of the Interior	The Bureau of Mines supplied an inventory of the type and extent of the mineral industry, both current and projected. Major reservoir project sites were reviewed for existing and potential mineral resources.	J	XI	Mineral Resources
	The Bureau of Outdoor Recreation made studies of the supply and demand aspects of recreation within a distinct area of influence. From this, needs were evaluated and a recreation plan of improvement developed.	I	X	Environmental Resources
	The Bureau of Sport Fisheries and Wildlife provided an inventory of the fish and wildlife needs, studied the effect of water resource development and recommended	I	X	Environmental Resources

TABLE 52

RESUME OF COOPERATING AGENCIES WITH REPORTING ASSIGNMENTS (CONTINUED)

Cooperating Agency	Assignment	Appendix	Volume Number	Title
Department of the Interior (Continued)	measures to secure the maximum fish and wildlife benefits.			
	The National Park Service inventoried the historical, archaeological, and natural science aspects of the Basin.	I	X	Environmental Resources
	The U.S. Geological Survey prepared a report on ground water with a treatise on the geology affecting it, location, extent, hydrologic characteristics and sources.	G	VIII	Ground Water
Environmental Protection Agency	The Federal Water Quality Administration determined present and projected future minimum stream flows, present and future municipal and industrial water supply needs and aided in the development of withdrawal schedules and the volume determinations for water quality and water supply storages in reservoir project plans under consideration.	F	VII	Water Use and Stream Quality
Department of Transportation	The Department of Transportation through the Federal Highway Administration, Bureau of Public Roads, reviewed proposals for highway relocations and provided needed coordination with existing highway programs.			
Federal Power Commission	The Federal Power Commission furnished power values and had projections for potential hydroelectric projects in the basin and provided an assessment of future electric power requirements.	K	XII	Power
Wabash Valley Interstate Commission	The Wabash Valley Interstate Commission participated on a broader front informing the public, encouraging coordination and making special studies.			
Illinois, Indiana and Ohio	The States of Illinois, Indiana, and Ohio furnished valueable information, technical review and staff for work-group activities throughout the investigation of the report.	M	XIV	State Reports



COMPREHENSIVE PLANNING CONCEPTS

FIGURE 91

The first detailed step in establishing water and related land resources requirements was to initiate the economic base study which evaluated economic factors throughout the basin and made projections of future values. The results formed a common base for determination for gross demands in terms of products and services. The appendices by participating agencies provided basic data and analyses of the various categories of demand on water and related land resources. The requirements were established as those remaining after deducting the capabilities of the going programs from the gross requirements. Assessments were made for present and projected resources. Requirements were compared with resources available, and potential means of satisfying unfulfilled requirements were established. These assessments provided a choice of alternative solutions to the many problems. The plan formulation writings later in this section provide an outline of the procedures followed in formulation of the plan of development.

Objectives

Earlier, we summarized the objectives of our comprehensive water and related land resources planning. Before the details of plan formulation are documented, perhaps a more formal presentation of these objectives and their origin is in order.

On 6 October 1961, President Kennedy requested the Secretaries of the Interior; Agriculture; Army; and Health, Education and Welfare review evaluation standards and to recommend improvements. Their report, "Policies, Standards, and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources", was approved by the President on 15 May 1962. This document, which is hereafter referred to as "Planning Policies" was published as Senate Document Number 97, 87th Congress, 2nd Session.

Section II of Planning Policies states:

> "The basic objective in the formulation of plans is to provide the best use, or combination of uses, of water and related land resources, to meet all foreseeable short- and long-term needs. In pursuit of this basic conservation objective, full consideration shall be given to each of the following objectives and reasoned choices made between them when they conflict."

Planning Policies, continues with a listing of elements to be considered under development, preservation, and well-being of people. While concepts have changed somewhat over the years, there has been general acceptance of these basic objectives. What had been lacking is the adequate development of standard procedures for making them meaningful in the planning process. For this report, the Coordinating Committee has considered development objectives under national income and regional development categories. Preservation has been broadened to include environmental objectives which encompass the intent of several major Congressional enactments and has attempted to define more carefully the objectives that have been classed as social or well-being objectives.

The basic reason for considering multiple objectives in investment planning is that the Executive Branch and the Congress have from time to time indicated clearly, that various objectives are relevant in water resources planning. This being the case, it follows that these objectives should be used in plan and project design because it can be demonstrated that where multiple objectives are relevant, projects designed in accordance with some balance among these objectives in general result in much closer approaches to meeting the objectives of investment that projects designed simply in terms of one objective and then modified or were chosen on an ad hoc basis that includes consideration of other objectives.

National Income Objectives

National Income measures the Nation's output as the aggregate earnings of labor and property which arise from current and future production. The increase in national income attributable to a project or plan is the measure of its contribution to this objective. These gains result from provision of water supplies for domestic, municipal, agricultural, and industrial uses; water quality control; navigation facilities; power; flood control; land stabilization; drainage; watershed protection; and outdoor recreation and fish and wildlife opportunities.

Regional Development Objectives

The Regional Development objectives embrace several related components such as (1) increased regional income, (2) increased regional employment, (3) improved regional economic base, (4) improved income distribution within the region, and (5)

improved quality of services within the region. Income gains in the region would include national income gains accruing to the region. However, not all national income gains arising from a project in a region necessarily accrue to that region. Where policy and goals seek to bring about an improved geographic distribution of economic development through expansion of economic activity in the region, the effects of projects or program activities toward achieving such goals will be considered as regional development benefits. These regional development objectives are closely related to the well-being objective of personal income distribution.

Environmental Objectives

The environmental objectives include the conservation, preservation, creation, or restoration of natural, scenic and cultural resources in order to enhance or maintain the quality of the environment. These objectives are closely allied to all efforts to conserve natural resources, including (1) the preservation or enhancement of aesthetic areas including open and green space, white rivers, lakes, beaches, shores, mountains and wilderness areas, estuaries, or related areas of unique natural beauty; (2) the protection of areas of archeological, historical, or scientific value; (3) the protection or improvement of water quality including the prevention of salt water intrusion and control of pollution from all forms of waste, drainage, and (4) the prevention of erosion and the restoration of erosion areas, with particular emphasis on the treatment of watersheds, lands areas, and critical erosion areas including gully, stream bank, roadside, and other land beach erosion. A major consideration of environmental objectives is to conserve natural resources so that they will be available when needed and the freedom of choice by future users will not be impaired.

Social Objectives

In addition to national income, reasonable development and environmental objectives, other well being or social objectives consider the personal, group, and community effects of the project or program activity. Since some of these well being objectives have a location impact there is a close relation to regional development objectives. Included are such objectives as security of life and health, national defense, personal income distribution, and inner regional employment and population distribution.

Security of life and health are enhanced by reducing risk of floods and other disaster to human life and by reducing the hazards to health associated with water development and use. National defense objectives are served by providing critical water supplies, goods, or transportation requirements or by providing needed reserve capacities and protection against interruption of the flow of goods at the time of critical needs. Objectives of personal income distribution are determined by national policies that specify arrangements for distribution of project benefits at cost among groups of beneficiaries. The distribution of population employment over the Nation is a national concern if the effects of projects on such distribution should be indicated so that such effects can be related to national policy considerations.

Projection Periods

For a comprehensive plan of regional scope, more than an evaluation of the water and related land resource problems and needs under current conditions of demand and supply was required. Consideration had to be given to interpretation of the total problem in terms of balancing the water product needs of a growing population and associated economic trends by means of a program of water development which would provide the satisfaction of such needs over a given period of growth. Accordingly, projections of population, labor force, employment, and agricultural activity were made. The results of these studies are presented in Appendix B – Economic Base Study.

The processes of aggregation underly the basic methods used in this study for projecting both population and employment by counties for integrating county data into economic subarea and study area analyses. Aggregative processes involve combining net migrations with net natural increases or decreases, providing the basis for projecting total population changes from more or less historical trends for individual counties. Employment projections by counties were based on aggregations of historical employment series for various industrial segments in the study area, as extrapolated and modified to account for foreseeable developmental impacts in the future.

Identifiable historical trends of population and employment were first extrapolated and then modified throughout the projection period to account for the most reasonable rates of change and

total change for each county individually. Initially, historical trends of increase or decrease were extrapolated by straight line by ten year extensions to either 1980, 2000, or 2020, to sufficiently establish significant rates and directions of change by counties. Subsequent rates of change adjustments were made by leist square formulae to correct county trends, decade by decade, to indicate total population and employment changes for the entire study area by the year 2020. Thus, modifications were made to correct mechanically extrapolated county trends by decade to decade series of adjustments in the historically indicated rate of increase or decrease. This process was incorporated into an equation and programmed for a computer to accomplish the adjustments for each county along a smooth curvilinear trend over the projection period. The implicit assumption of this basic formula, corresponding to a modified expotential function, is that the processes of inter-county migrations of population and specialization within continuing local industries both tend to build up counter-forces as they progress which will cause the more extreme short-term rates of growth or decline to taper off in somewhat cyclical patterns over time. Thus, the economic projection period used for the Wabash River Comprehensive Study was fifty years, terminating at 2020 with intermediate points or projection at 1980 and 2000; however, it is for note, that Senate Document Number 97 indicates that the economic evaluation of a project shall encompass the period of time over which the project will serve a useful purpose. To firm up and lend credence to the assessment of benefits to projects which were considered to have an economic life of over 50 years, primary reliance was placed on reasoned extrapolation of the economic projections of the first fifty year period.

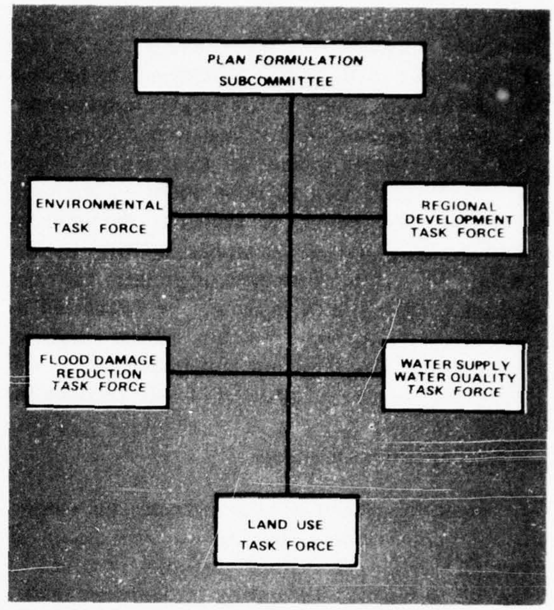


FIGURE 92
ORGANIZATION

PROCEDURES

As was pointed out earlier in the report, various work groups were formed by the Coordinating Committee, as necessary, for conducting certain study phases. Prior to the formulation phase, in early 1969, the Plan Formulation Subcommittee and five task forces were formed; as shown earlier in figure 92.

Functions and responsibilities of the work groups are outlined in Appendix A – History of Study and summarized in table 53 below. These descriptions are illustrative of the basic nature of the functions and responsibilities assigned. However, they are not necessarily complete nor are they intended to be inclusive of additional directly-related functions and responsibilities found necessary during the course of the study.

The basic organizational element, the Plan Formulation Subcommittee, was responsible for overall direction and coordination of plan formulation activities and formulation and recommendations of a specific basin plan to the Coordinating Committee. The subcommittee established and implemented detailed guidelines for plan formulation activities, directed development and comparative evaluation of alternative and tentative Coordinating Committee plans in providing for the interchange of information between Task Force groups. This Subcommittee was responsible for reviewing progress, establishing schedules, resolving any disagreements, and preparing the Main Report and Appendix C – Plan Formulation.

Plan Formulation during the course of the Wabash Study is illustrated in figure 93. Prior to April 1969, the principal efforts in the study had been directed toward collecting and evaluating the basic data to formulate the projects of three interim

TABLE 53

DESCRIPTION OF ORGANIZATION

Plan Formulation Subcommittee. This subcommittee was responsible for overall direction and coordination of plan formulation activities and formulation and recommendation of a specific basin plan to the Coordinating Committee. The subcommittee established and implemented detailed guidelines for plan formulation activities, directed development and comparative evaluation of alternative and tentative Coordinating Committee plans in providing for the interchange of information between Task Force groups. This Subcommittee was responsible for reviewing progress, establishing schedules, resolving any disagreements, and preparing the Summary Report Appendix on Plan Formulation.

Flood Damage Reduction Task Force. This task force was responsible for compiling a basin wide inventory of estimated average annual present and projected future flood damages, categorized as to mainstem and tributary reaches. The Task Force identified and evaluated all feasible alternative means, both structural and non-structural for reduction of the present and projected future flood damages.

Water Supply and Water Quality Task Force. This task force was responsible for compiling the basin wide requirements for municipal and industrial water supply and water quality control. The compilation will indicate both quantitative and qualitative water requirements. The task force considered various feasible alternative means for meeting the water supply and water quality needs of the basin.

Recreation, Fish and Wildlife and Environmental Resources Task Force. The task force compiled estimates of basin wide needs for water and related land resources, general outdoor recreation and fish and wildlife recreation and enhancement. It compiled inventories of existing outdoor recreation facilities and of resource potentials to meet additional present need and projected future needs. It compiled inventories of fish and wildlife resources and environmental resources (historical, archaeological, ecological, etc.) of significant value. It identified and evaluated the needs and potentials for preservation, protection, enhancement, public enjoyment, research and/or educational, or other treatment of environmental elements of significant value, as might best serve the public interest in both present and future. It evaluated the effects of considered water resources and other development plans upon environmental, recreational and fish and wildlife resources, and the potentials afforded thereby for development of joint purpose plans.

Land Use Task Force. This task force was responsible for the determination and evaluation or present and future land use needs, and the land potentials available to meet such needs, to best serve the overall public interest. It assisted in evaluating the total costs, both direct and indirect, and other socio-economic adverse effects, of land acquisition required to serve the purposes of considered water resources or other development plans. It defined measures, where pertinent, to avoid conflicts of desirable uses and/or to enhance joint purpose scope and benefits in such developments. It developed additional plans for those lands outside the immediate area and effects of other project development but within the overall areas of "related land resources," fo optimum utilization, considering agriculture, forests, miner resources recovery, industry, urban and suburban develo ments, transportation and/or other potentials as determine for the specific areas.

Regional Development Task Force. This task forc inventoried existing plans and planning studies that wer made by various public and private agencies for region and/or local developments, both present and future, whic are not basically water-oriented. Review and appraisal o existing plans were accomplished to identify needs fo coordination of the Wabash Basin studies, in order to avoi conflicts in program objectives and development and t effect optimization of benefits to the public. It identifie future coordination measures necessary to achieve the sam objectives in respect to planning studies now underway fo regional or local developments and for those which will b undertaken in the future. In addition to those concerned i the existing plans and studies referred to above, it reviewe other areas in the Wabash Basin and nearby zones o influence as to needs for similar regional planning. particular objective of such review was to identify indicate present and/or probable future development needs on th basis of current and projected future deficiencies in the loc economy and other public welfare values. Such identifie regional development needs were limited to those whic could not be satisfied in the absence of available water i adequate amounts, quality, location, etc. or those whic would be dependent in major degree upon such wate availability. It gave special attention and emphasis to thos areas where current or expectable early future conditio indicated deficiencies in presently available water whic would seriously inhibit healthy growth to meet the economi improvement and other indicated public welfare needs of th area. The task force assisted and advised other Wabash Stud organizational elements in the coordination of resul developed from the foregoing procedures and in the pla formulation processes. It evaluated the regional developme inducements afforded by the coordinated Basin Plan finally adopted by the Coordinating Committee for th Summary Report and was responsible for preparation of a ıppendix and other portions of the Summary Report, as we required, on matters within the sphere of regional and loc planning and developments related to the Wabash Study general indicated above.

Public Information Subcommittee. The Coordinating Co mittee at its 18th meeting established a subcommittee f public information with the State of Indiana's representati as the chairman. Each agency was entitled to a representati on the subcommittee. The Coordinating Committee discuss the problems of public information with the Water Resour Council and received their suggestions at the 19 Coordinating Committee meeting. The first meeting of t Public Information Subcommittee took place on 5 Augu 1969 at Indianapolis, Indiana. Methods of disseminating t Wabash Comprehensive Plan to the public were discuss Further discussion occurred at later meetings.

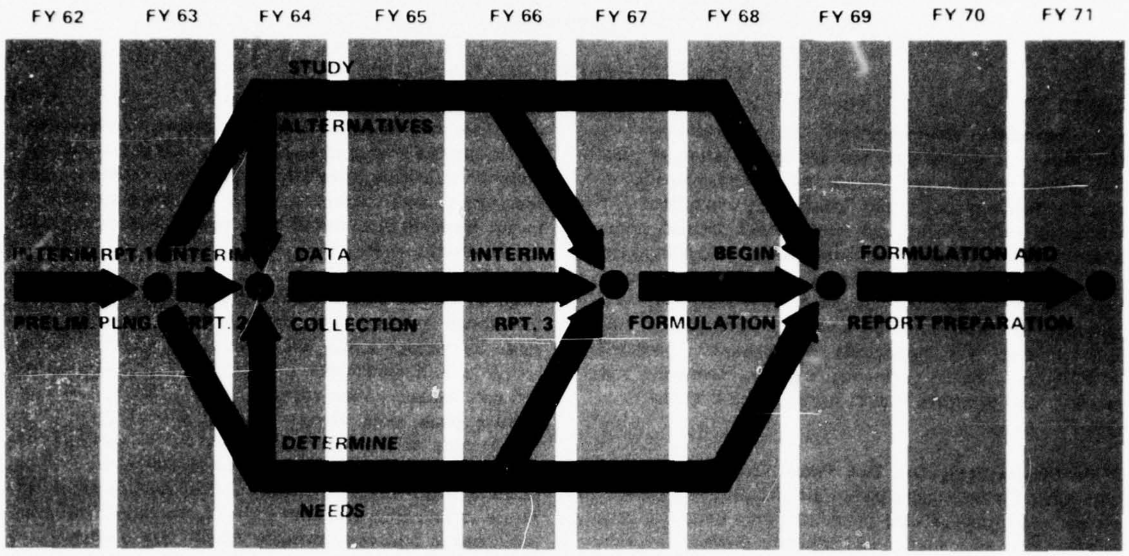


FIGURE 93

COURSE OF WABASH RIVER BASIN STUDY

reports and to support the overall formulation of a basin plan. Early in the basin formulation work, the Coordinating Committee recognized that portions of the basin or individual streams could be specified for development or preservation in line with one or more of the basic study objectives. The Coordinating Committee members, particularly those representing the three states, were asked to provide the Formulation Subcommittee with their objective preferences through the Regional and Environmental Task Forces as planning guides in formulating the Subcommittee's recommendation for a plan.

The fundamental procedure in plan formulation was to first define a national income efficiency plan and then modify this plan in the interest of regional, environmental and social objectives. It was not considered reasonable in our current spectra of knowledge, to try to develop mutually exclusive plans for each of the study objectives, and then by some arrangement, combine or apportion them into a single plan.

Task Force members composed of representatives of the various Federal and State agencies involved in the study identified water and related land resource needs in addition to those being met by existing, under construction, authorized and proposed projects and programs and determined the extent of these unsatisfied needs. Individual agencies participating then made preliminary, or reconnaissance investigations to determine potential solutions for meeting the unsatisfied needs within the individual areas of agency concern. Multiple-purpose and objective aspects of all possible solutions were studied in order to develop a balanced plan. Each agency also determined a tentative priority and timing for their projects and programs.

Existing, under construction, and certain of the authorized and proposed projects in the basin were a necessary part of the comprehensive plan. The proposed and additional projects and programs selected for the comprehensive plan by the Plan Formulation Subcommittee were divided into two time-phased categories based on the urgency of meeting the needs. One category, the Early Action Plan adds to the existing projects and authorized programs those projects which exhibit economic feasibility and will be needed to meet 1980 demands. A second category, the Long Range Plan adds to the Early Action Plan those additional projects which will be needed to meet the 2020 demands. Because of the various interests and responsibilities of the many agencies and States participating, there were diverse views on some of the plan elements considered; by and large, these conflicts were resolved.

PUBLIC INVOLVEMENT

Even the best government or private efforts to achieve a comprehensive plan with regard to any public objective cannot be effective without strong citizen support. The first imperative of the Coordinating Committee's task was to reach a representative cross-section of the public. Perhaps the first attempts at public information date back to the subbasin hearings which were held to secure views and desires of local interests as to the desirability of a comprehensive study. Initially, general meetings of the Coordinating Committee were opened to the public on a request basis; later some of the meetings were given wide publicity to update the public on the planning in each of the hydrologic subbasins. Special meetings were held throughout the study in response to requests by particular interest groups and individuals who felt a need for specific or general information. Ten public hearings on major reservoir projects were conducted. Table 54 presents a summary of hearings and meetings. Perhaps the most significant of the public relation efforts, however, were those put forth in a brochure, "The Wabash Basin – Water Resources Planning", and five public forums. Brochure contents concentrated on the problems of the basin and an explanation of what would be done in the comprehensive study. Response from the Public Forums was valuable not only in terms of specific changes that were made in plan elements, but also in terms of the less tangible, and more far reaching improvement in communications between the Federal and State planners, and local interests that

TABLE 54

PUBLIC HEARINGS AND FORMAL MEETINGS 1/

Place of Meeting	Area of Consideration	Date of Meeting	Registered Attendance	No of Exhibits	Public Opinion
SUBBASIN HEARINGS					
Greenup, Illinois	Embarras River	25 Jan 1962	958	138	Favorable
Bedford, Indiana	East Fork White River	18 Sep 1962	612	407	Favorable
Fairfield, Indiana	Little Wabash River	7 Aug 1962	653	74	Favorable
Jasper, Indiana	Patoka River	28 Aug 1962		126	Mixed
Spencer, Indiana	West Fork White River	11 Dec 1962	431	157	Favorable
PROJECT HEARINGS					
West Lafayette, Indiana	Lafayette, Big Pine, and Turkey Run Reservoir	15 Feb 1963	746	163	Opposed to Turkey Run Res
Charleston, Illinois	Lincoln Reservoir	10 Dec 1963	1,380	735	Favorable
Columbus, Indiana	Clifty Creek Reservoir	11 Dec 1963	149	122	Favorable
Jasper, Indiana	Patoka Reservoir	12 Dec 1963	535	572	Favorable
Greencastle, Indiana	Big Walnut Reservoir	19 Oct 1965	474	75	Favorable
Marion, Indiana	Marion Local Protection	4 Nov 1965	90	30	Favorable
Fairfield, Illinois	Helm Reservoir	9 Nov 1965	209	76	Favorable
Louisville, Illinois	Louisville Reservoir	10 Nov 1965	451	89	Favorable
Greensburg, Indiana	Downeyville Reservoir	15 Dec 1965	226	134	Favorable
Shelbyville, Indiana	Big Blue Reservoir	16 Dec 1964	198	73	Favorable
PUBLIC FORUMS					
Carmi, Illinois	Lower Wabash, Patoka and Little Wabash Basins	2 Jun 1970			
Terre Haute, Indiana	Middle Wabash and Embarras Basins	3 Jun 1970			
Wabash, Indiana	Upper Wabash Basin	22 Jun 1970			
Columbus, Indiana	East Fork White River	23 Jun 1970			
Indianapolis, Indiana	West Fork White River	24 Jun 1970			
SPECIAL MEETINGS					
Marion, Indiana	Marion Local Protection	1 Aug 1963			Favorable
Marion, Indiana	Marion Local Protection	1 Jul 1964			Favorable

1/ Navigation Public Hearings are not included in this table.

would be most directly affected by the Comprehensive Basin Plan. Even though all requested changes could not be accommodated, the Plan results clearly summed to reflect citizen preferences and expectations to a greater degree than before the discussions began, and confirmed that, on the whole, the Comprehensive Basin Plan was in keeping with the public's desires.

In summary, the public information program and in particular the Public Forums formed a new pattern of cooperation between the planning staffs and the public. The effort brought a new stimulation to all – the Federal agencies, to other levels of government, to business and industry in the region and to a host of citizen groups. A sounding board was provided for an expanded public and private effort to cope with fundamental water and land related problems.

DEVELOPMENT OF THE NATIONAL INCOME EFFICIENCY PLAN

Flood Prevention

Projects to satisfy major segments of widespread needs for flood control in principal watercourse areas were selected from successive determinations by discrete screenings applied to 174 potential major dam sites in all parts of the basin. Further evaluations were applied to many of these sites and to an array of potential alternative measures in the final selection process. Thirteen major reservoirs were selected as elements of the plan of development; projects are scheduled for development in accordance with the multipurpose needs. The first group of six projects, listed in table 55, would be needed for multiple-purposes by 1980. A second group of seven projects, also listed in table 55, would be needed by 2020. Major reservoirs in the plan are described individually in Attachment A at the rear of this volume, and their respective locations are indicated on figure 98 of this section.

The entire flood control program to the year 2020 would reduce flood damages through storage, detention structures, local protection projects, land treatment and management, and flood plain regulation. The plan provides for ten thousand acre feet of storage in addition to the ten thousand acre feet in the Present Plan-December 1968. Of the new storage, four thousand acre feet is available in the thirteen selected major reservoirs, and one thousand is in the five selected upstream watershed structures.

Most of the upstream impoundment sites studied are located south of the Wisconsin glacial boundary, see figure 10, in areas of considerable topographic relief. As mentioned in Section IV, over 1,400 upstream structure sites were identified for study. Of these, slightly more than 1,200 were found to have some degree of development capability. These identified sites do not necessarily reflect all possible alternate locations; many of the sites have not had geologic investigations made and may not be physically feasible due to adverse subsurface conditions. The Upper Wabash, Mississinewa, Salamonie, Vermilion, Tippecanoe, Eel and Wildcat River drainage areas are practically devoid of good storage sites in the upstream areas due to the lack of topographic relief. Only about seven percent of the identified sites are located in these subbasins, which comprise about 30 percent of the total basin area. A majority of the sites in these areas have capability of storage for single purpose flood prevention or single purpose water supply only. Only one-third have capacity for multiple-purpose water storage. Approximate locations of both major and upstream sites considered are shown on figure 94.

Total available storage in the reservoirs studied varied from less than one inch of runoff from the drainage area to an excess of 40 inches; about 70 percent have storage capacity for multiple-purpose use. Table 56 contains pertinent data on the potential upstream watershed projects available in each hydrologic subbasin. Eight-hundred fifty-six sites have sufficient storage for flood prevention and additional capacity for such purposes as recreation, water quality control, water supply, fish and wildlife or irrigation. The greatest concentration of sites are found in the East Fork, West Fork, Little Wabash, Patoka and Embarras Subbasins. Two hundred-thirty-seven sites have storage capacity available for single purpose flood prevention structures or single purpose water supply structures. One hundred-twenty-eight sites have insufficient capacity for flood prevention storage, but have limited storage capacity available for single purpose water supply only.

Optimum development and proper preservation measures of water and related land resources in the

TABLE 55

MAJOR RESERVOIR PROJECTS RECOMMENDED AND CONSIDERED

Reservoir	County	State	Stream	Purpose[1/]
Early Action Plan				
Azalia	Bartholomew Jackson Jennings	Indiana	Sand Creek	FC,R
Deputy	Jefferson	Indiana	East Fork Muscatatuck River	FC,R,WQ,F&W
Parker	Delaware Randolph	Indiana	West Fork White River	FC,R,WS,WQ
Crawfordsville	Montgomery	Indiana	Sugar Creek	FC,R,WS,WQ,F&W
Salt Fork	Vermilion	Illinois	Salt Fork	FC,R,WQ,F&W
Fall Creek	Hamilton Hancock Marion	Indiana	Fall Creek	FC,R,WS,WQ,F&W
Long Range Plan				
Maltersville	Dubois	Indiana	Straight Creek	FC,R
Martinsville	Johnson Marion Morgan	Indiana	West Fork White River	FC,R,F&W
Denver	Miami Wabash	Indiana	Eel River	FC,R,F&W
Pipe Creek	Miami	Indiana	Pipe Creek	FC,R,F&W
Deer Creek	Carrol	Indiana	Deer Creek	FC,R,F&W
Delphi (Upper)	Carrol Cass	Indiana	Wabash River	FC,R,F&W
Coal Creek	Fountain	Indiana	Coal Creek	FC,R

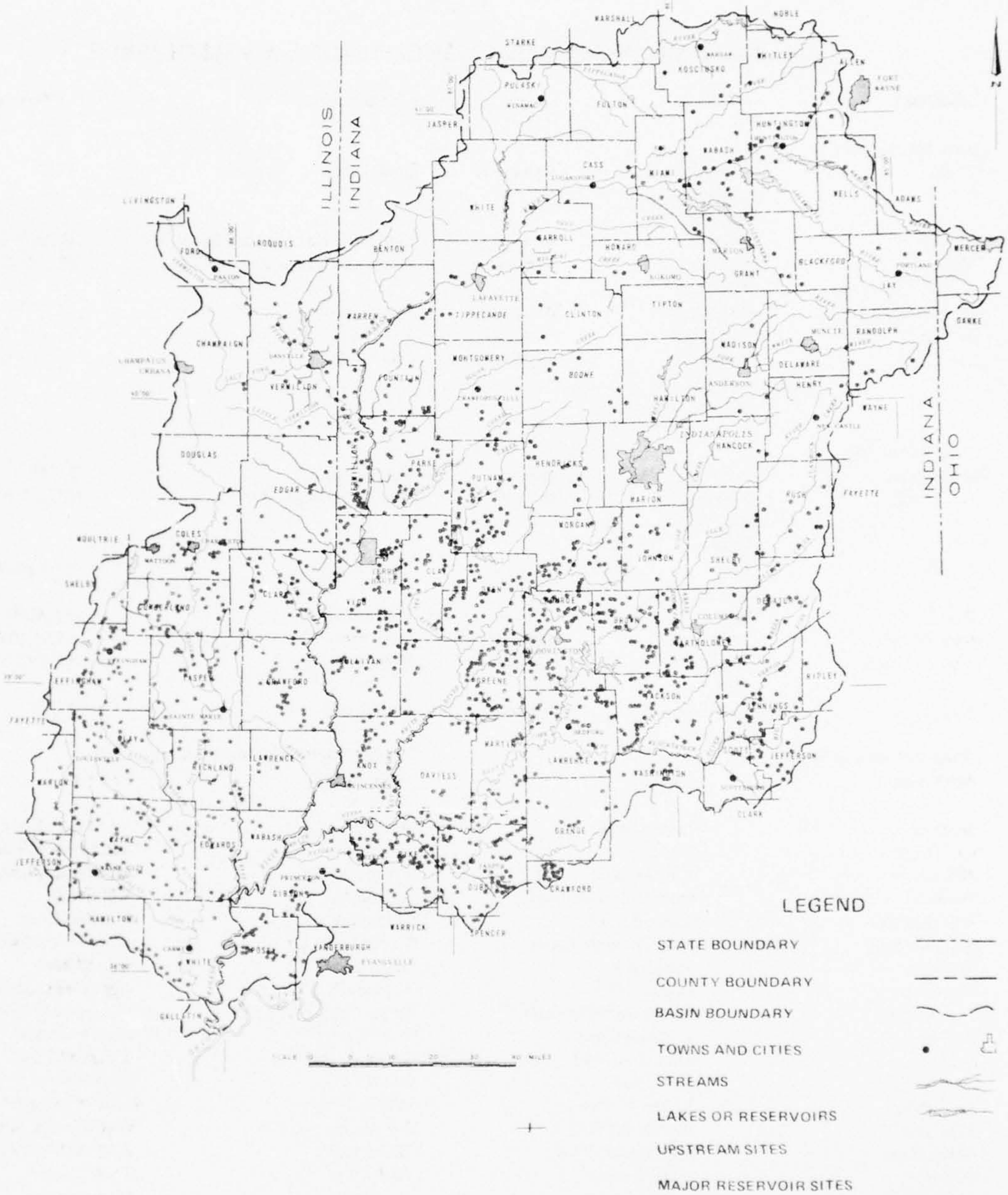
Other Considered Projects

Reservoir	Stream
Winslow	Patoka River
Flat Creek	Flat Creek
Millport	Muscatatuck River
Shoals	East Fork White River
Vernon Fork	Vernon Fork
Bean Blossom	Bean Blossom Creek
Fortville	Fall Creek
Frankton	Pipe Creek
Perkinsville	West Fork White River
Killbuck	Killbuck Creek
Spencer	West Fork White River
Boy Scout	Fall Creek
Mooresville	Whitelick Creek
Richland	Richland Creek
Tippecanoe	Tippecanoe River
Delphi	Wabash River
Petes Run	Wildcat Creek
Big Creek	Big Creek
Brouilletts	Brouilletts Creek

Other Considered Projects (Continued)

Reservoir	Stream
Danville	Vermilion River
Kickapoo	Middle Fork Vermilion
Little Vermilion	Little Vermilion
Mill Creek	Mill Creek
Montezuma	Wabash River
North Fork Vermilion	North Fork Vermilion
Sugar Creek	Sugar Creek
Sugar Mill	Sugar Mill Creek
North Fork Embarras	North Fork Embarras
Woodbury	Muddy Creek
Crooked Creek	Crooked Creek
Elm River	Elm River
Wilcos Bridge	Little Wabash River
Big Muddy	Weather-Big Muddy Creek
Effingham	Little Wabash River
Fox River	Fox River
Horse Creek	Horse Creek
Brush Creek	Brush Creek
Bonpas	Bonpas Creek

1/ FC - Flood Control; R - General Recreation; WS - Water Supply; WQ - Water Quality; FW - Fish and Wildlife Recreation and Conservation.



MAJOR AND UPSTREAM RESERVOIR SITES CONSIDERED

FIGURE 94

TABLE 56

UPSTREAM WATERSHED PROJECTS RECOMMENDED AND CONSIDERED

Watershed Name	CNI Number	Purpose 1/
Early Action Plan		
Patoka Subbasin		
Hunley-Eel (P20&21)	17i-6	FP,R,WQ,M&I
Upper Patoka River Tributary (P32&34)	17i-3	FP,WQ,M&I
Hall-Flat Creek (P22)	17i-4	FP,R,WQ,M&I
East Fork White River		
Aikman Creek (EFW-2)	17h2-45	FP,D
Lost River (EFW-10)	17h2-41	FP,R,M&I
Upper Vernon Fork (EFW-30U)	17h2b-1	FP,R,M&I,WQ
Lower Vernon Fork (EFW-30L)	17h2b-2	FP,R,D,F&WL
Pond Creek (EFW-27)	17h2b-7	FP,R,D
Little Salt Creek (EFW-37)	17h2-23	FP
White Creek and Beatty-Walker Ditch (EFW-42&43)	17h2-15	FP,R,D
Denios Creek (EFW-48)	17h2-10	FP,R
Lewis Creek (EFW-52)	17h2-5	FP,D
Upper Big Flatrock River (EFW-54)	17h2-1	FP,M&I,F&WL,D
Delaney Creek (EFW-25)	17h2b-8	FP,I,R
Brandywine Creek (EFW-61)	17h2a-4	FP,D
Little Blue River (EFW-63)	17h2a-3	FP
West Fork White River		
Veale Creek (WFW-2)	17hl-49	FP,R
Black Creek (WFW-9)	17hl-45	FP,R,WQ,D
Lagoon Ditch, Wabash and Erie Canal (WFW-24&26)	17hla-14&16	FP
Splunge Creek (WFW-29)	17hla-13	
Birch Creek (WFW-30)	17hla-11	FP,WQ
Jordan Creek (WFW-33)	17hla-8	FP,R
Croys Creek (WFW-35)	17hla-6	FP,R
Deer Creek (WFW-37)	17hla-4	FP,R
Little Walnut (WFW-38)	17hla-2	FP,R
Rattlesnake Creek (WFW-43)	17hl-30	FP,R
Bryant Creek (WFW-52)	17hl-25	FP,R
Whitelick Creek (WFW-60)	17hl-20	FP,R,WQ
Killbuck Creek (WFW-84)	17hl-3	FP,D
Wilson Creek (WMS-5)	17h-3	FP,R,WQ,M&I
Upper Wabash River		
Clear Creek (UW4)	17-9	FP,D
Little River (UW5)	17-8	FP,R,D,WQ
Buckeye-Hoosier (UW9-20)	17-2-3	FP,R,WQ,D
Salamonie River (S15)	17-12	FP,D,R
Pony Creek (Eel 12)	17b-3	FP,D
Lower Mississinewa River (M7 thru M15)	17a-2	FP,R,F&WL
Upper Mississinewa River (M16&17)	17a-1	FP,D
Brown-Hill (T9)	17c-21	FP,D
Big Monon Ditch (T13)	17c-20	FP,D
House-Bartee (T32&33)	17c-9	FP,D
Mud Creek (T36)	17c-7	FP,D
Sugar Creek (MS77)	17-39	FP,D,R
Rock Creek (Cass Co)(MS83)	17-33	FP,D
Burnetts Creek (MS85)	17-31	FP,D
Crooked Creek (MS87)	17-31	FP,D
Goose Creek (MS103)	17-26	FP,R

TABLE 56

UPSTREAM WATERSHED PROJECTS RECOMMENDED AND CONSIDERED (CONTINUED)

Watershed Name	CNI Number	Purpose 1/	No Structu
Middle Wabash River			
Vieke Ditch (MS12)	17-105	FP,D	—
Raccoon Creek (Illinois)(MS14)	17-107	FP,D	—
City Ditch (MS15)	17-103	FP,D	—
Snapp-Kelso (MS19)	17-103	FP,R	1
Mariah Creek (MS21)	17-102	FP,R,D	2
Lower Shaker Prairie (MS22)	17-101	FP,D	—
Turtle Creek (MS29)	17-93	FP,R,I	8
Mill Creek (Illinois)(MS35)	17-87	FP,R	8
Snyder Creek (Illinois)(MS35)	17-85	FP	1
Honey Creek (MS42)	17-77	FP,R	8
Sugar Creek (Illinois)(MS44)	17-75	FP,M&I,WQ	2
Otter Creek (MS47)	17-71	FP,R	5
Coal Creek (MS55)	17-55	FP,R	2
Fall Creek (MS64)	17-51	FP,R	1
Feather Creek (MS101)	17-68	FP,R	1
Big Raccoon Creek (BR4)	17-62	FP,R,F&WL	8
Jordan Creek (V7)	17e-7	FP,D	—
Lye Creek (SC14)	17f-3	FP,D	—
Embarras River			
Brushy-Birch Creek (E3&4)	17g-3&4	FP,R,WQ	5
Muddy Creek (E5)	17g-5	FP,D,WQ	2
North Fork Embarras River (E11)	17g-11	FP,R,WQ,M&I	12
Crooked Creek (E12)	17g-12	FP,R	5
Muddy Creek (E21)	17g-21	FP,R,M&I,WQ	6
Brushy Creek (E33)	17g-33	FP	—
Little Wabash River			
Lick Creek (LW2)	17j-2	FP,R	2
Auxier-Big Creek (LW12)	17jl-12	FP,R,M&I,D	4
Big Mound (LW14)	17jl-14	FP,D	1
Dry Fork (LW15)	17jl-15	FP,R,M&I	4
Horse Creek (LW18)	17jl-18	FP,R,M&I	5
Pond Creek (LW28&29)	17j-28&29	FP,R	1
Fox River (LW39)	17j-39	FP,R,M&I,WQ	5
Big Muddy Creek (LW42)	17j-42	FP,R	7
Salt Creek (LW51)	17j-51	FP,R	4
Upper Little Wabash River (LW52)	17j-52	FP,WQ,M&I	7
Lower Wabash River			
Big Creek (MS1)	17-125	FP,R,D	10
Gresham Creek (MS3)	17-121	FP,R,D	13
McHenry-Hawthorne			
Scott Ditch and Coffee Bayou (MS6&8)	17-113	FP,R,D	3
Bonpas Creek (MS100)	17-117	FP,R,WQ,D,M&I	9
LONG RANGE PLAN			
Patoka River			
Flat Creek	17i-12	FP,M&I	1
Cup Creek	17i-9	FP,R,M&I	2
East Fork White River			
Sugar and Slate Creek	17h2-40	FP,R	[illegible]
Sulphur Creek	17h2-34	FP,R	[illegible]

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TABLE 56

UPSTREAM WATERSHED PROJECTS RECOMMENDED AND CONSIDERED (CONTINUED)

Watershed Name	CNI Number	Purpose 1/	No of Structures
East Fork White River (Continued)			
Gutherie	17h2-24	FP,R,M&I	3
Buffalo Creek	17h2-20	FP,R	2
McHargue Ditch	17h2-17	FP,D	1
John Thompson Ditch	17h2-13	FP	—
Big Slough	17h2-6	FP	—
Youngs Creek	17h2-6	FP	2
Bear Creek	17h2-44	FP,R	1
West Fork White River			
Doans Creek	17hl-40	FP,R	2
Lick Creek	17hla-17	FP,R	6
Pond Creek	17hla-15	FP	—
Six Mile Creek	17hla-10	FP,R	5
Hog McIntyre	17hla-7,9	FP,R	2
Fish Creek	17hl-32	FP,R	6
Burkhart Creek	17hl-24	FP,R	1
Clear Creek	17hl-19	FP,R	1
Pipe Creek	17hl-5		
Upper Wabash River			
Scuffle Creek	17-14	FP,D	
Eel River	17b-1	FP	1
Timmons Ditch	17c-19	FP,D	
Ackerman Ditch	17c-18	FP,D	
Quigley Marsh Ditch	17c-11	FP,D	
Fell-Taylor Ditch	17c-9	FP,D	
Chapman Creek	17c-8	FP,D	
South Fork Wildcat Creek	17d-2	FP,D	
Deer Creek	17-36	FP,D	
Pleasant Run Creek	17-34	FP,D	
Rattlesnake Creek	17-34	FP,D	
Middle Wabash River			
Crawfish Creek	17-110	FP,D	
Turman Creek	17-91	FP	2
Raccoon Creek (Illinois)	17-88	FP,R	2
Big Creek (Illinois)	17-82	FP,R	4
Clear Creek (Illinois)	17-76	FP,R	2
Lost Creek	17-73	FP	1
Norton Creek	17-68	FP,R	2
Big Shawnee Creek	17-52	FP,D	
Cole Branch	17e-3	FP	1
Stony Creek (Illinois)	17e-11	FP,D	
Sugar Mill	17f-10	FP,R	3
Little Sugar Creek	17f-5	FP,D	
Embarras River			
Otter-Beaver Allison	17g-2-37,36	FP,D	
Honey Creek	17g-7	FP,R	2
Range Creek	17g-20	FP,R	3
Hurricane Creek	17g-23	FP	2
Little Wabash River			
Limekiln Creek	17jl-6	FP,D	
Lost Creek	17jl-8	FP	2

TABLE 56

UPSTREAM WATERSHED PROJECTS RECOMMENDED AND CONSIDERED (CONTINUED)

Watershed Name	CNI Number	Purpose 1/	No of Structures
Little Wabash River (Continued)			
Beaver Creek	17jl-9	FP	
Prairie Creek	17jl-10	FP,D	
Nameless Creek	17jl-11	FP,M&I	1
Brush Creek	17jl-21	FP	2
Elliott Creek	17j-24	FP	
Big Creek	17j-27	FP	
Elm River	17j-34	FP,R	13
Panther Creek	17j-44	FP	2
Crooked Creek	17j-45	FP	1
Dismal Creek	17j-46	FP	1
Bishop Creek	17j-50	FP,M&I	2
Lower Wabash River			
Black River	17-120	FP,R	4
French Creek	17-118	FP,R	2

CONSIDERED WATERSHEDS

Hydrologic Subbasin and Type	Potential Number of Sites	Hydrologic Subbasin and Type	Potential Number of Sites
Patoka River		Middle Wabash River	
Multiple-purpose	91	Multiple-purpose	57
Single purpose (FP or WS)	4	Single purpose (FP or WS)	35
Single purpose (WS only)	1	Single purpose (WS only)	51
East Fork White River		Embarras River	
Multiple-purpose	199	Multiple-purpose	57
Single purpose (FP or WS)	35	Single purpose (FP or WS)	43
Single purpose (WS only)	27	Single purpose (WS only)	7
West Fork White River		Little Wabash River	
Multiple-purpose	260	Multiple-purpose	88
Single purpose (FP or WS)	34	Single purpose (FP or WS)	64
Single purpose (WS only)	9	Single purpose (WS only)	15
Upper Wabash River		Lower Wabash River	
Multiple-purpose	27	Multiple-purpose	25
Single purpose (FP or WS)	18	Single purpose (FP or WS)	4
Single purpose (WS only)	18	Single purpose (WS only)	—

1/ FP - Flood prevention; M&I - Municipal and industrial water supply; WQ - water quality control; I - Irrigation; R - recreation; F&WL - Fish and wildlife; D - Drainage; WS - Water supply.

basin depends not only on the impoundments potential emphasized thus far, but also upon the application and extension of a variety of land and water programs. These programs depend in large measure upon sustained action by local interests. Nevertheless, the particular programs relative to flood control are discussed in the paragraphs below and are considered worthwhile features of the comprehensive plan for the Wabash Basin.

The impoundment measures discussed above can be used effectively to produce many of the desired results in the water resources sector. However, it is relatively obvious, in a basin such as the Wabash, where flood plains are extensive and damages are primarily agricultural that the total use of structures to completely satisfy flood control needs would be geographically, physically and economically impractical. In considering this aspect of the problem, attention was given to controlled use of flood plains as a supplemental means of flood damage prevention and for providing needed goods and services in the environmental area. Controlled use of flood plains encompasses such measures as prevention of channel encroachment, zoning to regulate the use of the flood plains, flood proofing, adjustments in the occupance of structures in the flood plain, evacuation of the flood plain either on a permanent basis to provide for parks and other flood damage free developments or as a temporary basis by flood warning arrangements, and, finally, combinations of these various measures.

In fact, zoning and similar devices for controlling flood plain development are said to come under the general category of policing powers, delegated by the Constitution, to the States, and, interim, usually delegated to counties, townships, and municipal governments. In the Wabash River basin, the power is delegated by the States of Illinois, Indiana and Ohio, to some extent, to these various political subdivisions. The widespread application of reasonable uniform zoning or other programs to control the use of flood plains throughout the Wabash River basin would take on monumental proportions, but would not necessarily be an impossible undertaking. The application on these programs to individual areas of flood potential seems highly practical under conditions now prevailing. Some thirty communities, presented later in Section VII, have been identified as having specific needs for flood plain management services. If substantial measures are implemented at these communities an estimated 50 percent of the remaining annual damages by 2020 can be eliminated.

At this juncture, it was considered that the most realistic program for supplementing the structural measures of these communities should include: a) making all or any part of the great assemblageof flood data developed for this report available to those planning, zoning, or other supplemental programs to ameliorate flood problems; b) encourage the basin states and their political subdivisions to develop comprehensive flood plain regulations and to fully utilize information relative to flood plain management in the development of plans to guide the utilization of flood plans. Such plans should be developed not only for areas in which flood damages cannot be eliminated or reduced economically by structural measures, but also for application in areas where structural measures for flood control already exist or are proposed as features of the comprehensive plan; c) expand the flood warning system to include electronic monitoring devices at appropriate locations in all subbasins.

Where flood control is the sole or dominant need of a basin or locality, levees, floodwalls and channel improvements are often found to be suitable solutions for these problems. In this investigation where a multiplicity of needs are being considered on a coequal basis, the relative efficiency and economy of local protection measures must be appraised in arriving at appropriate development decisions. It is indicated in Section II that the basin is characterized by wide stream valleys that are cluttered with highways, railroads and numerous small communities. Such physical characteristics generally permit economic use of floodwalls and levees because of the large area protected per unit length of the protection measure. Studies were made to determine the relative economy of local protection measures at various locations, fourteen are recommended in table 57.

Water Supply

As is indicated by a review of the basin water supply requirements, the Wabash region is a complexity of urban developments, localities and indiviudal users. These requirements were developed and projected on the basis of population and industrial growth and, in the case of municipal water supply, the estimated increases in per capita

TABLE 57

LOCAL PROTECTION PROJECTS – RECOMMENDED AND CONSIDERED

Project	County	State	Stream	Length (Miles)
EARLY ACTION PLAN				
Patoka Unit 2	Gibson	Indiana	Patoka	3.31
Patoka Unit 3	Gibson	Indiana	Patoka	6.63
Patoka Unit 4	Gibson-Pike	Indiana	Patoka	3.98
Patoka Unit 5	Gibson	Indiana	Patoka	2.69
West	Bartholomew	Indiana	East Fork White	6.80
Wiemeyer	Bartholomew	Indiana	Clifty Creek	1.20
Beatty	Bartholomew	Indiana	East Fork White	4.60
East Fork Unit 5	Bartholomew	Indiana	East Fork White	4.10
East Fork Unit 17	Jackson	Indiana	East Fork White	4.30
Little Wabash Unit 7	Wayne	Illinois	Little Wabash	4.80
Little Wabash Unit 8	Wayne	Illinois	Little Wabash	3.56
Lower Wabash Unit 50	Posey	Indiana	Wabash	7.20
LONG RANGE PLAN				
Little Wabash Unit 3	Wayne	Illinois	Little Wabash	9.00
Little Wabash Unit 9	Richland	Illinois	Little Wabash	6.60
OTHER CONSIDERED PROJECTS				
Patoka Unit 7	Pike	Indiana	Patoka	N.A.
East Fork Unit 4	Bartholomew	Indiana	East Fork White	6.0
East Fork Unit 15	Pike	Indiana	East Fork White	N.A.
East Fork Unit 16	Jackson	Indiana	East Fork White	7.25
Hazelton	Gibson	Indiana	White	0.65
West Fork Unit 30	Knox	Indiana	White	6.13
Fores and Atkinson	Knox	Indiana	West Fork White	4.70
Spencer	Owen	Indiana	West Fork White	1.75
West Fork Unit 11	Morgan	Indiana	West Fork White	N.A.
West Fork Unit 12	Morgan	Indiana	West Fork White	4.73
West Fork Unit 13	Morgan	Indiana	West Fork White	3 40
West Fork Unit 36	Johnson	Indiana	West Fork White	2.93
Vincent and Paddock	Morgan-Johnson	Indiana	West Fork White	3.57
Landersdale	Morgan	Indiana	Goose Creek	5.03
Dunn, Harmon and Reiny	Marion	Indiana	West Fork White	N.A.
Embarras Unit 1	Crawford-Lawrence	Illinois	Embarras	16.49
Embarras Unit 2	Lawrence	Illinois	Embarras	3.25
Little Wabash Units 3 and 4	White	Illinois	Wabash-Little Wabash	28.2
West Fork Unit 35	Morgan	Indiana	West Fork White	2.5

N.A. - Not available.

usage of water. Projected water needs for irrigation, stock watering and rural residences were defined by the Department of Agriculture based on indicated trends in land use and farming practices.

The net water requirements determined for this study represent basin needs for further water resource development by 1980, and they reflect a trend of future basin needs for the projection period to 2020. In addition, significant needs for additional water supply exist in a number of areas adjoining the basin. In formulating the plan, consideration was given to construction of reservoir projects to supply out-of-basin needs where firm and specific needs were in evidence. The final formulation stage involved the determination of practical solutions to the water supply problems; the best, least expensive and most feasible means of meeting the additional needs was the objective. Consideration was given both surface and ground water sources involving major reservours, upstream watershed sites, well field development and purchase from other communities with adequate supplies. For each area needing water, cost data and benefits were analyzed for all practical alternative means of supplying water. To illustrate the extent of alternative sources evaluated, table 58 is presented.

TABLE 58

DISCUSSION OF WATER SUPPLY ALTERNATIVES

Problem Area	Additional Resources by Plan Formulation (Average Daily MGD)	Remarks
PATOKA SUBBASIN		
Jasper	5.2	To be obtained from Patoka Reservoir.
Huntingburg	1.8	Small watershed project provides least cost alternative.
Princeton	5.2	Least cost alternative provided by ground water west of city.
EAST FORK WHITE SUBBASIN		
New Castle	10.1	9.6 mgd developable from ground water and stream flow; SCS project on Big Blue can provide remainder through 2020.
Shelbyville	7.4	Additional supplies to be furnished by ground water.
Greenfield	6.2	Develop ground water as needed southwards toward Big Blue River.
Edinburg	3.5	Least cost alternative is development of ground water.
Franklin	5.8	Least cost alternative is development of ground water.
Columbus	74.0	Needs can be met by ground water and stream flow.
Greensburg	2.2	Least cost alternative is to develop ground water with withdrawals from Downeyville Reservoir near 2020.
Vernon and North Vernon	2.0	Least cost alternative provided by SCS Vernon Fork project.
Bloomington	22.4	Can be met from storage in Monroe Reservoir.
Monroe County	3.0	Least cost alternative is development by local impoundments.
WEST FORK WHITE SUBBASIN		
Winchester	5.6	Least cost alternative is development of ground water and utilizing storage in Parker Reservoir near 2020.
Mt. Summit	1.2	Ground water provides least cost alternative.
Muncie	39.2	Least cost alternatives include pumping from White River to Prairie Creek Reservoir, development of additional ground water and utilization of 30 mgd from Parker Reservoir by 2020.
Fortville	0.6	Development of ground water is least cost alternative.
Anderson	21.3	Least cost alternatives are development of additional ground water with needs beyond 1985 met by Parker Reservoir.
Alexandria	4.3	Additional well fields seen as least cost alternatives.
Elwood	4.8	Additional well fields seen as least cost alternative with possible future withdrawal from White River.
Tipton	1.3	Additional ground water least cost alternative.
Noblesville	1.4	Additional ground water least cost alternative.
Indianapolis	200.0	Least cost alternative is development of additional ground water sources to 1980; after 1980, needs to be met by ground water and Fall Creek, Parker, Big Walnut and Big Blue Reservoirs.
Brownsburg	2.6	Continued development ground water is least cost alternative.
Plainfield	2.3	Continued development ground water is least cost alternative.
Danville	0.7	Continued development ground water is least cost alternative.
Mooresville	0.8	Develop ground water as least cost alternative.
Martinsville	3.5	Develop ground water as least cost alternative.
Greencastle	8.8	Develop ground water as least cost alternative.
Brazil	4.3	Develop ground water as least cost alternative.
Linton	1.3	Develop ground water as least cost alternative.
Washington	3.0	Develop ground water as least cost alternative.
Bicknell	0.7	Develop ground water as least cost alternative.
UPPER WABASH SUBBASIN		
Huntington	7.5	Develop ground water as least cost alternative.
Bluffton	2.4	Develop ground water as least cost alternative.
Portland	6.3	Develop ground water as least cost alternative.
Union City	4.6	Develop ground water as least cost alternative.

TABLE 58

DISCUSSION OF WATER SUPPLY ALTERNATIVES (CONTINUED)

Problem Area	Additional Resources by Plan Formulation (Average Daily MGD)	Remarks
UPPER WABASH SUBBASIN (CONTINUED)		
Hartford City	11.9	Develop ground water as least cost alternative.
Marion	21.5	Develop ground water as least cost alternative.
Wabash	11.0	Develop ground water as least cost alternative.
North Manchester	1.0	Develop ground water as least cost alternative.
Warsaw	9.0	Develop ground water as least cost alternative.
Columbia City	3.2	Develop ground water as least cost alternative.
South Whitley	1.2	Develop ground water as least cost alternative.
Peru	6.1	Develop ground water as least cost alternative.
Rochester	1.5	Develop ground water as least cost alternative.
Winamac	3.0	Develop ground water as least cost alternative.
Kokomo	72.3	Least cost alternative in continued development of ground water. reuse of industrial water, possible withdrawals from Mississinewa Reservoir and possible utilization of storage in Pipe Creek Reservoir.
Frankfort	2.80	Least cost alternative is continued development of ground water.
Monticello	1.7	Least cost alternative is continued development of ground water.
Lafayette	58.6	Least cost alternative is ground water development and stream flow.
Flora	0.5	Least cost alternative is ground water development and stream flow.
Delphi	0.6	Least cost alternative is ground water development and stream flow.
MIDDLE WABASH SUBBASIN		
Lebanon	1.1	Least cost alternative is development of ground water.
Fowler	1.0	Least cost alternative is development of ground water.
Rural Warren County Industry	38.0	Least cost alternative is development of ground water.
Attica	3.8	Least cost alternative is development of ground water.
Crawfordsville	15.3	Development of ground water is least cost alternative with later withdrawals from surface water impoundments and stream flow. Early action Crawfordsville Reservoir available for future supply.
Rockville	0.8	Least cost alternative is to develop ground water.
Rural Vermilion County Industry	26.4	Least cost alternative is to develop ground water.
Terre Haute Area	119.2	Development of ground water is least cost alternative with withdrawals from Wabash furnishing bulk of supply by 2020.
Sullivan	1.1	Least cost alternative is to develop ground water.
Vincennes	17.8	Least cost alternative is to develop ground water.
Hoopeston	5.6	Development of ground water is least cost alternative.
Rossville	0.7	Development of ground water is least cost alternative.
Danville	44.6	State plans to build reservoir of 30 mgd capacity in near future. Later needs to be met by ground water development.
Georgetown	1.5	Least cost alternative likely to be development of surface water impoundments or develop source away from local area, possibly from state reservoir near Danville.
Rantoul	2.8	Development of ground water is least cost alternative.
Urbana-Champaign	16.0	Development of ground water is least cost alternative.
Remainder of Champaign County	0.52	Development of ground water is least cost alternative.
Marshall	5.9	Development of ground water is least cost alternative.
Robinson	11.9	Development of ground water is least cost alternative.
Paris	6.4	Least cost alternative is impoundment on Sugar Creek in conjunction with water quality control needs.
EMBARRAS SUBBASIN		
Lawrenceville	1.12	Develop ground water as least cost alternative.
Newton	0.28	Least cost alternative for future supply likely to be stream flow releases from Lincoln Reservoir.

TABLE 58

DISCUSSION OF WATER SUPPLY ALTERNATIVES (CONTINUED)

Problem Area	Additional Resources by Plan Formulation (Average Daily MGD)	Remarks
LITTLE WABASH SUBBASIN		
Mattoon	3.8	Least cost alternative is purchase of water from SCS project.
Olney	2.4	City is presently developing water supply reservoir on East Fork of Fox River which will meet needs through study period.
Fairfield	2.9	Least cost alternative is utilization of storage in authorized Louisville Reservoir.
LOWER WABASH SUBBASIN		

NOTE: Data are for localities that have present supplies of a million gallons per day.

Each of the water requirements of the Wabash Basin can be met by various methods. Some of these, such as curtailed use, pricing and reclamation of waste waters, are neither socially acceptable or politically practical at this time in the region, indeed the nation. Weather modification has little to offer as an alternative; the average amount of annual rainfall and runoff in the Wabash Basin is more than adequate to provide enough water to meet foreseeable needs.

Electric Power

There are no economically justified single purpose hydroelectric potentials in the basin. However, there are seven sites in the Power Region which have a total hydroelectric potential of about 245,000 KW. Generation at these projects would amount to about 780,000 megawatt-hours annually. Table 59 gives pertinent data for each of these potential hydroelectric developments. The Clinton and Delphi sites have the largest potential capacity; both of these developments are located on the mainstem of the Wabash River which lies in a glacial till plain with low bank and wide flood plains. These conditions generally make the river unsuitable for hydroelectric damsites. None of the basin reservoirs were found to be economically feasible for power development at this time.

Besides hydroelectric power potential, the water use and consumption of the power industry has been another consideration of this study. Even though enormous amounts of power are projected for generation through the projection period to 2020, this is only of general concern when compared with the total amounts of water available. The concern in this matter relates to the fact that peak generating rates occur in the summer when streams are low, and consequently, large amounts of water for cooling are withdrawn from streams during low flow periods.

TABLE 59

POTENTIAL HYDROELECTRIC PROJECTS

Plant	River	Gross Head (Ft)	Average Annual Energy (1,000 KWH)
Petersburg	White	28	130,000
Lost River	E Fk White	28	70,000
Shoals	E Fk White	57	110,000
Spencer	W Fk White	54	60,000
Clinton	Wabash	62	225,000
Delphi	Wabash	74	160,000
Danville	Vermilion	60	25,000
TOTAL			**780,000**

In table 60, the comparison is made between the consumptive water requirements of all projected power plants simultaneously generating at their capacities, admittedly a remote possibility, versus the total amount of water available in the various subbasins at one-day, one-in-30-year low flow. On this basis, it is evident that by 2020 sufficient generating capacity will have been installed to consume about 40 percent of the present one-day,

TABLE 60

ELECTRIC POWER – CONSUMPTIVE WATER USE AND LOW FLOWS

Hydrologic Subbasin	1980 Capacity (1,000 KW)	1980 Evaporation (CFS)	2000 Capacity (1,000 KW)	2000 Evaporation (CFS)	2020 Capacity (1,000 KW)	2020 Evaporation (CFS)	1-day, 1-in 30 years Low Flow (CFS)
Patoka	7	0.094	0	0	0	0	0 at Princeton
East Fk White	0	0	0	0	0	0	135 at Shoals
West Fk White	2,000	26.9	6,500	83	22,000	256	550 at Petersburg
Upper Wabash	94	1.26	7,500	100	13,500	159	410 at Lafayette
Middle Wabash	2,500	33.6	7,000	87	23,000	266	840 above White River
Embarras	0	0	0	0	0	0	2.0 at Lawrenceville
Little Wabash	9	0.12	0	0	0	0	0.4 at Carmi
Lower Wabash	19	0.26	1,500	18	8,500	100	1,700 at Mt. Carmel
TOTAL	**4,629**	**62**	**22,500**	**288**	**67,000**	**781**	**1,950 at Mouth**

NOTE: Evaporation shown does not differentiate between evaporation from recirculating type cooling devices and the evaporation due to once-through cooling. Except for 1980, when a small amount of once-through cooling will be used, evaportation will be due to recirculating type water using cooling devices.
Assumed: 75 percent of waste heat dissipated through evaporation. Energy lost from plant other than through cooling water: 15 percent for coal; 5 percent for muclear.

one-in-30-year low flow from the entire Wabash River basin, and somewhat more than that from some of the subbasins. Although the above is of an extreme case, it points up that electric power generation, if it grows as projected, will require substantial amounts of the minimum flow from the entire basin.

Thus minimum amounts of water available for all beneficial uses must be a part of site surveys by power companies and must be a limiting consideration in the granting of licenses by Federal and State regulatory agencies. Where thermal power plants are to be constructed in the same areas with urban concentrations, the power plant should be located downstream from the urban areas, so as to take advantage of treated waste water returns and to eliminate interfering with other beneficial uses of water upstream from and through the urban areas.

Water Quality Control

Water quality control programs, procedures and needs are described in detail in Appendix F – Water Use and Stream Quality. Needs were estimated for the projection period to 2020. Estimated supplemental flow and other developmental requirements were based on projected waste discharges to streams from cities, industries, and other sectors, as expected from population and employment projections in Appendix B – Economic Base Study. Criteria for determining the quality requirements were based on the water quality standards adopted by the respective basin states. Parameters used as a measure of existing and potential water quality included dissolved oxygen, biochemical oxygen demand, total dissolved solids, chlorides, sulfates, nutrients, color, temperature, turbidity and other selected criteria for the protection of stream uses designated by the states.

In meeting the needs of quality control, advanced waste treatment was considered in all cases, but because of the continuing changes in technology, it was necessary to utilize standard and regionally acceptable methods of advanced waste treatment for the purposes of this report. The methods include sedimentation, activated sludge,

chemical coagulation with associated treatment, rapid sand filtration, granular carbon absorption and electroliolysis. The adopted methods may not be the best ones, nor eventually the least expensive ones, but they are proven methods for which costs are available.

Industrial pre-treatment was considered as a method of preventing heavy waste loadings from reaching conventional or advanced municipal waste treatment plants. Pre-treatment was considered to include good housekeeping practices and process changes as well as plants screening and private treatment plant operation. Other acceptable alternatives to advanced waste treatment include transportation of waste water to streams having adequate or improved assimilative campacity and flow regulation through releases from storage in Federal or state reservoirs, which are under construction, authorized, proposed, considered, or identified as potential sites, depending on the period for which they are needed. Some advanced waste treatment processes, especially fossiliferous and ammonia nitrogen removal, are proposed in conjunction with other methods of meeting standards, especially where large quantities of these materials will affect reservoirs or create potential dangers further downstream.

Other possibilities, those of flow augmentation from ground water and in stream aeration were largely ruled out for the Wabash River basin. The groundwater supply was deemed to be too small and too well used to consider flow augmentation from this source. Locations which could benefit from instream aeration such as below Indianapolis, were passed over because this method primarily removes BOD leaving the more refractory materials to be passed downstream. Table 61 summarizes the larger municipal areas and their considered development needs; only the advanced waste treatment measures or alternatives have been included as a part of the Comprehensive Plan.

Thus far, we have concerned our discussion principally with the municipal and industrial treatment measure, but as was learned in Section V – Problems and Needs, our concern is much broader. Water pollution control has been accomplished in the past by providing treatment or flow augmentation commensurate with the ability of the stream to assimilate without harm to downstream users. As population and industrial growth increases, however, the waste loadings discharged into some streams, even after treatment, eventually will exceed the assimilative potential of treatment and flow measures. Thus, further reduction of waste loadings in the basin can be accomplished by the following procedures which are outlined in detail in Appendix F.

That adoption of and especially the enforcement of industrial wastes and sewer use ordinances become widespread in the basin.

That nutrients from both municipal and agricultural sources be minimized by regulation, technological changes and research.

That basin water quality monitoring systems be expanded.

That stream banks be given treatment consideration to reduce the potential suspended solid load.

That electric power plant conversion from once-through cooling systems to off-channel systems proceed with deliberate haste.

That abandoned mined areas be reclaimed to improve the quality of the streams draining them.

One of the more serious quality problems outside the urban sector is that of mine drainage abatement. The problem is all the more difficult because there is still a great need for additional research to find new, better and more efficient methods of treating the polluted waters draining from coal mines. The Middle Wabash and Patoka Subbasins contain the majority of the Basin's present surface mined areas. Nine square miles of this area are proposed for treatment in the Early Action Plan.

Agricultural Conservation and Management

Because of the basic nature of the land there are no known feasible alternatives to basic erosion control and the preservation of the soil resouce base for the future food and fiber production needs of the nation. Essentially agricultural conservation and

TABLE 61

MUNICIPAL WATER RESOURCE DEVELOPMENT NEEDS

Community	Present Treatment	Control Combined Sewer Overflows	Effluent Disinfection	Known Needs for New or Improved Secondary Treatment Facilities	Increment of Comprehensive Plan Advanced Waste Treatment, Flow Augmentation, Other Control Measures
PATOKA RIVER					
Jasper	Secondary		B (12/72)		B (12/77)
Huntingburg	Secondary + Cl				B (12/77)
Princeton	Secondary		D - EA		B (12/77)
EAST FORK WHITE RIVER					
New Castle	Secondary	B (12/77)	C (12/72)		B (12/77)1/
Greenfield	Secondary + Cl	B (12/77)			B (12/77)
Franklin	Secondary		C (12/72)		B (12/77)
Rushville	Secondary	B (12/77)	C (12/72)	B (12/72)	B (12/77)1/
Columbus	Secondary + Cl	B (12/77)			D - LR
Greensburg	Secondary + Cl	B (12/77)			B (12/77)1/
North Vernon	Secondary	B (12/77)	C (12/72)		B (12/77)
Austin2/	None			D - EA	D - EA
Scottsburg	Secondary + Cl	B (12/77)			B (12/77)
Mitchell	Secondary		D - EA		D - EA
Bloomington4/	Secondary + Cl				B (12/77)
Loogootee	Secondary + Cl	B (12/77)			D - EA
Paoli	Secondary + Cl				B (12/77)
French Lick (West Baden)	Secondary + Cl				B (12/77)
Shelbyville	Secondary + Cl				3/
Edinburg	Secondary	B (12/77)	D - EA		
Brownstown	Primary + Cl			D - EA	
Seymour	Primary + Cl	B (12/77)		D - EA	
Bedford	Primary + Cl			D - EA	
New Whiteland	Secondary + Cl			B (12/68)	B (12/77)
WEST FORK WHITE RIVER					
Winchester	Secondary + Cl				B (12/77)1/
Muncie	Secondary	B (12/77)	B (12/70)		B (12/77), C (6/77)
Anderson	Secondary + Cl	B (12/77)			B (12/77)
Alexandria	Secondary	B (12/77)	B (12/72)		D - EA
Elwood	Secondary	B (12/77)	B (12/72)		B (12/77)
Noblesville	Secondary		B (12/70)		
Tipton	Secondary	B (12/77)	B (12/70)		B (12/77)1/
Pendleton	Secondary + Cl	B (12/77)			D - EA 1/
Indianapolis	Secondary + Cl	B (12/77)			B (12/77)

TABLE 61

MUNICIPAL WATER RESOURCE DEVELOPMENT NEEDS (CONTINUED)

Community	Present Treatment	Control Combined Sewer Overflows	Effluent Disinfection	Known Needs for New or Improved Secondary Treatment Facilities	Increment of Comprehensive Plan Advanced Waste Treatment, Flow Augmentation, Other Control Measures
WEST FORK WHITE RIVER (Continued)					
Carmel	Secondary + Cl	B (12/77)		B (12/68)	D - EA[5]
Beech Grove	Secondary + Cl	B (12/77)		B (12/69)	B (12/77)[5]
Lawrence	Secondary + Cl	B (12/77)			B (12/77)[5]
Speedway	Secondary + Cl	B (12/77)			B (12/77)[5]
Zionsville	Secondary + Cl				D - EA[5] [1]
Greenwood	Secondary + Cl	B (12/77)			B (12/77)[5]
Homecroft	None	B (12/77)	C (12/67)	C (12/67)	D - EA[5]
Brownsburg	Secondary + Cl	B (12/77)			B (12/77), C (6/77)
Plainfield	Secondary + Cl	B (12/77)			B (12/77)
Danville	Secondary	B (12/77)	B (12/72)		B (12/77)
			C (7/72)		
Mooresville	Secondary		B (12/72)		D - EA
Martinsville	Primary + Cl			D - EA	
Greencastle	Secondary + Cl				B (12/77)
Brazil	Secondary	B (12/77)	D - EA		B (12/77)
Linton	Secondary		C (12/69)	B (12/69)	B (12/77)
Bicknell	None	B (12/77)	D - EA	B (12/70)	D - EA
Washington	Secondary + Cl	B (12/77)		B (12/68)	D - EA
Petersburg	Primary + Cl			D - EA	D - EA
Bloomington (Plant No. 2)	Secondary + Cl		C (12/68)	C (12/68)	B (12/77)
UPPER WABASH RIVER					
Bluffton	Secondary + Cl				A,C (12/77)[1]
Celina, Ohio	Secondary		B (6/1/68)		D - EA[1]
Coldwater, Ohio	Secondary + Cl			B (7/1/71)	D - EA[1]
Columbia City	Secondary + Cl	B (12/77)			B,C (12/77)
Delphi	Secondary + Cl				
Dunkirk	Secondary + Cl	B (12/77)			D - EA[1]
Fairmount[6]	Secondary + Cl	B (12/77)			D - EA[1]
Frankfort	Secondary		B (12/69)	B (12/69)	B,C (12/77)[1]
Gas City[6]	Secondary + Cl	A (12/77)			D - EA[1]
Hartford City	Secondary + Cl	B (12/77)		B,C (12/69)	B (12/77)[1]
Huntington	Secondary	A (12/77)	A,C (12/72)		A (12/77)
Jonesboro[6]	Secondary + Cl				D - EA[1]
Kokomo	Secondary + Cl	B (12/77)			B,C (12/77)[1]
Lafayette[7]	Secondary + Cl	A (12/77)			D - LR

TABLE 61

MUNICIPAL WATER RESOURCE DEVELOPMENT NEEDS (CONTINUED)

Community	Present Treatment	Control Combined Sewer Overflows	Effluent Disinfection	Known Needs for New or Improved Secondary Treatment Facilities	Increment of Comprehensive Plan Advanced Waste Treatment, Flow Augmentation, Other Control Measures
UPPER WABASH RIVER (Continued)					
Logansport	Secondary + Cl	A (12/77)		C (12/69)	
Marion	Secondary + Cl	A (12/77)			A,C (12/77)1/
Monticello	Secondary + Cl	B (12/77)		B,C (12/69)	1/
Montpelier	Secondary + Cl	B (12/77)			D-LR
North Manchester	Secondary + Cl	B (12/77)			
Peru	Secondary + Cl	A (12/77)			D - LR
Portland	Secondary + Cl	B (12/77)			B,C (12/77)1/
Rochester	Secondary + Cl				
South Whitley	None	B (12/77)	C (12/70)	B,C (12/70)	
Union City	Secondary	B (12/77)	B,C (12/72)		B (12/77)1/
Wabash	Secondary	A (12/77)	A,C (12/72)		D - EA
Warsaw and Winona Lake	Secondary + Cl			B,C (12/69)	B (12/77)1/
West Lafayette7/	Primary + Cl	A (12/77)		A,C (7/1/71)	7/
Winamac	Primary + Cl			D - EA	1/
MIDDLE WABASH RIVER					
Attica, Indiana	Secondary + Cl	A (12/77)			
Covington, Indiana	None	A (12/77)		A (12/70)	
Paxton, Illinois	Primary + Cl			D - EA	C (7/72)1/
Rantoul-Chanute AFB, Illinois	Secondary		D - EA		D - EA1/
Urbana-Champaign, Illinois	Secondary	C (7/72)8/	C (7/72)	C (7/72)	C (7/72)1/
Hoopeston, Illinois	Secondary	C (7/72)8/	C (7/72)		C (7/72)1/
Danville, Illinois	Secondary	A (1978) C (7/72)8/	A (7/72)		C (7/72)
Georgetown, Illinois	Secondary	A (1978) C (7/72)8/	A (7/72)		C (7/72)
Lebanon, Indiana	Secondary + Cl	B (12/77)			B (12/77)1/
Crawfordsville, Indiana	Secondary + Cl	B (12/77)			B (12/77)
Rockville, Indiana	Secondary		B (12/72)		D - EA
Clinton, Indiana	Primary	A (12/77)	A (12/72)	A (12/72)	
Terre Haute, Indiana	Primary + Cl	A (12/77)		A (12/72)	D - LR
Paris, Illinois	Secondary	A (1978) C (7/72)8/	A (7/72)		C (7/72)1/
Marshall, Illinois	Secondary	C (7/72)8/	C (7/72)		C (7/72)
Robinson, Illinois	Secondary	C (7/72)8/	C (7/72)		C (7/72)

TABLE 61

MUNICIPAL WATER RESOURCE DEVELOPMENT NEEDS (CONTINUED)

Community	Present Treatment	Control Combined Sewer Overflows	Effluent Disinfection	Known Needs for New or Improved Secondary Treatment Facilities	Increment of Comprehensive Plan Advanced Waste Treatment, Flow Augmentation, Other Control Measures
MIDDLE WABASH RIVER (Continued)					
Sullivan, Indiana	Secondary	B (12/77)	D - EA		B (12/77)
Vincennes, Indiana	Primary + Cl			A (12/72)	
EMBARRAS RIVER					
Tuscola	Secondary	C (7/72) 8/ B (3/78)	C (7/72)		C (7/72) 1/
Charleston	Secondary	B (3/78)	D - EA		D - EA 1/
Newton	Secondary		C (7/72)	C (7/72)	C (7/72)
Lawrenceville	Secondary + Cl	C (7/72) 8/ B (3/78)			
Mattoon	Secondary	C (7/72) 8/ B (2/78)	C (7/72)		C (7/72) 1/
Urbana-Champaign	Secondary		C (7/72)		
LITTLE WABASH RIVER					
Flora	Secondary	C (7/72) 8/	C (7/72)		C (7/72)
Albion	Secondary		C (7/72)		C (7/72)
Effingham	Secondary	B (3/78) C (7/72) 8/	C (7/72)	C (7/72)	C (7/72) 1/
Olney	Secondary		C (7/72)		B (3/78)
Fairlfied	Secondary	C (7/72) 8/	C (7/72)		C (7/72)
Carmi	Secondary		C (7/72)	C (7/72)	D - EA
LOWER WABASH RIVER					
Grayville	Primary		A (7/70)	A (7/70)	
Mount Carmel	Primary	A (1978) C (7/70) 8/	A (7/70)	A (7/70)	

1/ Includes need identified in this study for phosphorus removal for protection or existing or planned downstream lake or reservoir.

2/ While the municipality of Austin does not have a recognized sewer system, some sewers are believed to exist and a sanitary sewerage system is badly needed. A heavy industrial load is now produced in the community. For these reasons, the community is included in this listing.

3/ The Indianapolis Metropolitan area is rapidly expanding in the Buck Creek-Sugar Creek area east of Indianapolis. At this time, there are no large loads from the Indianapolis Metropolitan area being discharged to the East Fork White River basin; however, it is projected that this will occur in the future with the development of a regional system. Projected new loads in this area, along with projected loads in the Shelbyville vicinity, will create a future problem area downstream from Shelbyville, requiring flow regulation or advanced waste tr treatment to meet quality standards.

TABLE 61

MUNICIPAL WATER RESOURCE DEVELOPMENT NEEDS (CONTINUED)

4/ Refers to south plant which discharges to East Fork White River drainage.
5/ It is recommended that the wastewaters of this community be treated in a regionalized or central metropolitan area treatment plant for the economy of advanced waste treatment in a large scale plant and to eliminate continued discharge of waste waters to an intermittent or small stream in an urban area.
6/ Fairmout, Gas City and Jonesboro are considered together in discussing the water quality problems of the area.
7/ The Lafayette and West Lafayette areas are considered together in discussing the water quality problems.
8/ Indicates the date for elimination of sewage treatment plant bypassing or to provide treatment for up to ten times the normal dry weather flow.

NOTES:

A – Action indicated by State Implementation Plan, Interstate Water Quality Standards.
B – Action indicated by State Implementation Plan, Intrastate Water Quality Standards.
C – Action indicated by State Program Plan.
D – Action recommended by this plan. Action not specifically covered by Water Quality Standards or State Program Plan.
(xx/xx) – Month and year project is to be implemented; i.e., placed in operation.
EA - Early Action.
LR - Long Range.

management, more specifically, land and forest treatment, is concerned with land and water uses that will yield continuing returns to the people of the study area, the region, and the nation. Any developmental and preservation program must place sufficient emphasis on accelerating the land treatment measures that have a significant effect on reducing runoff, erosion and sediment production. Such measures would be implemented and designed to protect the agricultural lands and woodlands and increase overall forming efficiency. Thus, to meet the area's share of regional and overall market demands, land owners will have to capitalize on the potential of land resource development. This can be accomplished by the adoption of improved crop, timber and livestock production methods, and insofar as practical, use of land according to its capabilities.

The Basin's potential for protection and improvement of the water and land resource is reflected by the treatment needs discussed in Section V and in Appendix H – Agriculture. Over 90 percent of the basin has potential for improvement by application of land treatment measures to control erosion, excess water and improve unfavorable soil conditions. To reach full productive potential, 10.4 million acres or 73.7 percent of the cropland needs treatment to overcome physical problems. The major treatment needs are the use of crop residue and annual cover, drainage, the use of sod in rotation, strip cropping, terracing, and diversions. On the 1.4 million acres of pasture, 65.4 percent of the total pasutre land, plan cover improvement and reestablishment, brush control and protection from grazing are the major treatment needs. Refer to table 48 for the acreage breakdown by treatment need.

The hydrologic condition of the Basin's forest land varies from very poor to good; private forest lands are generally in a poor to fair hydrologic condition. There is a medium to high potential for improvement involving a number of factors – soil texture, soil depth, topographic position on slope and percent of slope. When land treatment measures are applied, a high degree of production and development is possible. Adequate measures result in increased growth rates, improved species composition and quality forest stands.

Basically, treatment needs reflect current problems and represent current needs for treatment. Existing land treatment programs will fall short of meeting these needs in the near future. Even with consideration of the accomplishments of the early action program including the going soil and water conservation district program, the small watershed program and the accelerated program above major reservoirs, an estimated 4.3 million acres would be untreated.

In view of this, consideration has been given to the potential for accelerating land treatment application during the next ten to fifteen years. The potential for three possible increments for accelerated application are shown below in table 62. Projected accomplishments for each of these includes that which would be accomplished by current going programs. The three options are 1) accentuate treatment in early action small watershed projects; 2) item 1) plus accelerated treatment in the drainage areas of major reservoirs; 3) accelerated treatment of all the basin lands.

TABLE 62
OPTIONS FOR ACCELERATED EARLY ACTION LAND TREATMENT

Item	Early Action Watershed Projects	Drainage Areas of Major Reservoirs	Basin-wide Acceleration
		(1,000 Acres)	
Crop	5,714	6,456	7,134
Pasture	803	901	993
Forest	408	615	736
Other	198	208	243
Total	7,123	8,180	9,106
Early Action Costs:	$251,684,000	$285,208,000	$312,364,000

Environmental Resources

General Recreation

The Wabash River basin offers a variety of opportunities for developing a basin recreation plan. One of the most critical problems confronting the establishment of any plan, particularly a recreation plan, is that of providing the area's populace with a quality environment which offers durable satisfaction. This task is of particular difficulty, because people, by their very numbers, presence and behavior, can destroy the very rewards they seek. Thus, it has been the foremost goal in formulating the basin recreation plan to take into account quality of opportunity for mass use as well as limited use and protection of designated areas.

Literature in the recreation field generally indicates that water is one of the major factors that attract people to outdoor settings. A major consideration in the basin is water in the form of reservoirs, lakes, and free flowing streams. The 1968 program, illustrated in figures 64, 65, and 66, indicates there are already six major Federal reservoirs and other developments supplying recreation opportunities. As recreation demand increases as projected, facilities at these existing reservoirs must be expanded to allow for the optimum use of these resources. Additional reservoirs, both large and small, will be required in future years to meet the growing demand for water dependent and water enhanced outdoor recreation opportunities. A number of reservoir sites were investigated during the site screening studies; recreation was included in all thirteen of the major reservoir projects and about one-third of the 147 small watershed projects in the comprehensive plan. These projects have an ultimate capability of furnishing 31,900,000 annual recreation days of the 200,000,000 recreation days demand projected for 2020.

To supplement the supply of future recreation opportunities within the limitations of resource availability and to provide for nonresident requirements, the recreation plan must rely on intensified efforts to increase public outdoor recreation facilities to accommodate almost six times the current use. In many cases, increasing demands can be satisfied by expanding existing facilities and by emphasizing the development of those resources not now utilized for recreation. However, to obtain a varied recreation plan, full development of existing facilities in all available areas should be vigorously planned. State parks, private development available for public use, and National Forest recreation sites can be expanded in most cases by increasing facilities to meet the need for greater public outdoor recreation opportunity.

It is expected that over 18.8 million user days can be accommodated at existing areas by 1980 and 31.2 million user days by the year 2020. In order to move toward the previously mentioned goal of 200 million user days annually by 2020, new areas must be developed to meet the additional needs within this framework of overwhelming demand, few alternatives are opened for true consideration.

Areas for high density use can be provided relatively close to major populations centers. Facilities in these locations can be constructed to meet mass use demands for outdoor recreation.

Indianapolis residents are expected to have great need for outdoor recreation areas within easy driving distance of the metropolitan area. The upper reaches of East Fork White River and Fall Creek are desirable locations for mass recreation with extensive water based recreation opportunities. Small impoundments in and around the Indianapolis area can also be used to meet the urgent needs for increased opportunities. Not all small impoundments would be adaptable; but where they are compatible with other uses, every effort should be made to combine their use. The smaller population centers are expected to require centers for recreation use too, construction of recreation areas close to these communities would help to meet these needs.

General outdoor recreation areas, such as state and local parks, river and lake recreation areas, could be located throughout the basin so as to provide outdoor recreation opportunities for both urban and non-urban residents and tourists. These areas should include sites subject to substantial development for a wide variety of uses which would sustain a considerable amount of activity in camping, picnicking, boating, swimming and cultural pursuits. Small reservoirs, in many instances, could be adapted for outdoor recreation. Access areas of various sizes could serve as local and state recreation areas. They could be sized to meet local or regional conditions, depending upon demands and phyiscal adaptability of the area.

Natural, historical, archaeological and cultural areas can provide additional but limited opportunities for recreation pursuits. These are included later in the Development of the Environmental Modifications and discussed in Section VII – The Comprehensive Plan. Table 63 and figure 95 summarize the identifiable recreation needs before and with the proposed plan; these needs include only those of general recreation.

TABLE 63

OUTDOOR RECREATION DEMAND, SUPPLY AND NEEDS

Economic Subarea	Year	Demand	Supply	Needs
		(Millions of Annual Recreation Days)		
1	1968	6.4	3.5	2.9
	1980	10.6	8.4	2.2
	2000	20.7	14.8	5.9
	2020	31.5	22.5	9.0
2	1968	17.7	1.8	15.9
	1980	26.9	8.0	18.9
	2000	48.6	12.2	36.4
	2020	69.2	15.6	53.6
3	1968	2.1	1.0	1.1
	1980	3.2	2.7	0.5
	2000	6.0	5.5	0.5
	2020	9.2	7.9	1.3
4	1968	7.2	2.1	5.1
	1980	10.4	6.3	4.1
	2000	17.8	9.8	8.0
	2020	25.8	14.0	11.8
5	1968	3.9	1.0	2.9
	1980	5.6	2.9	2.7
	2000	9.5	4.0	5.5
	2020	12.9	4.7	8.2
6	1968	12.9	3.2	9.7
	1980	20.1	5.9	14.2
	2000	36.3	8.2	28.1
	2020	53.0	11.0	42.0
TOTAL	1968	50.2	12.6	37.6
	1980	76.8	34.2	42.6
	2000	138.9	54.5	84.4
	2020	201.6	75.7	125.9

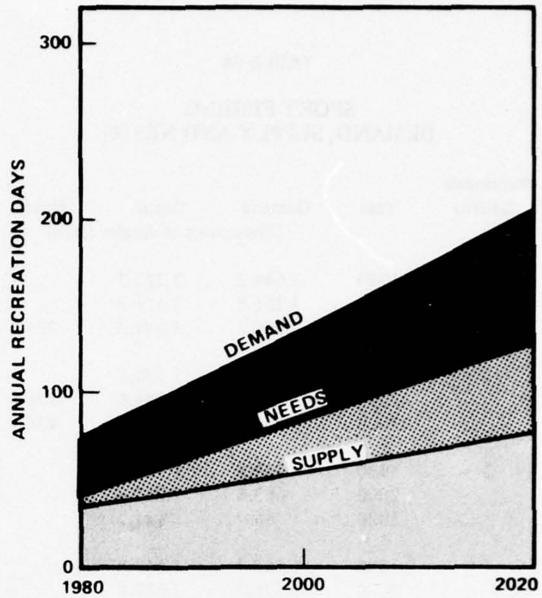


FIGURE 95

OUTDOOR RECREATION SUPPLY, DEMAND AND NEEDS

Fish and Wildlife

A balanced program of stream and reservoir improvement and development is needed to meet present and future fishing requirements.

In some locales in the basin the fish habitat will not support all future fishing demands even if optimum use of the lands and waters were realized. Investigations for this report have revealed numerous large and small reservoir sites well adapted to development. Those identified as having substantial potential for multiple-purpose use can offer a variety of fishing opportunities with proper management. The early action and long range segments of the major reservoirs and small watershed program would provide two million angler days; this compares with the demand presented in table 64.

Mining, including coal, sand, gravel and limestone operations, have created about 11,000 acres of surface water, and much of this can support a quality sport fishery. It is estimated that nearly one-half of this acreage is capable of supporting sport fish populations.

TABLE 64

SPORT FISHING
DEMAND, SUPPLY AND NEEDS

Economic Subarea	Year	Demand	Supply	Needs
		(Thousands of Angler Days)		
1	1980	2,644.2	3,222.7	
	2000	3,361.8	3,474.7	
	2020	3,910.3	3,688.8	221.5
2	1980	2,980.5	3,381.6	
	2000	3,721.5	3,344.6	376.9
	2020	4,203.3	3,748.8	454.5
3	1980	555.8	1,078.8	
	2000	663.6	1,012.8	
	2020	766.0	821.2	
4	1980	1,167.9	1,643.8	
	2000	1,378.0	1,567.8	
	2020	1,833.1	1,742.1	91.0
5	1980	922.3	1,117.9	
	2000	1,016.6	1,159.9	
	2020	1,097.4	1,260.4	
6	1980	3,176.4	2,839.5	336.9
	2000	3,860.8	2,881.5	979.3
	2020	4,306.4	3,280.8	1,025.6
TOTAL	1980	11,447.1	13,284.3	
	2000	14,002.3	13,441.3	561.0
	2020	16,116.5	14,542.1	1,574.4

Fishery management programs in future years can provide continuing better use of fishing resources and direct attention to areas of effort offering greater return to the angler. The States are the primary organized administrator of the Basin's fishery resources, and programs must be continued and increased to provide quality and quantity in the angler's catch. Such programs include aquatic plant control, rough fish eradication, improved stocking ratios, habitat improvement, maintenance of population balance, and provision and preservation of spawning areas.

Realization of the full potentials of the fishery plan and indeed the full potentials of the Basin's streams will require flow regulation to increase productivity and extend the period when conditions are favorable for sport fishing. Flow regulation can also permit needed stream fluctuations for best fish production. Regulated streamflow, along with sewage treatment and proper disposal of industrial wastes, would also reduce pollution problems and enhance the stream values.

Hunting

In formulating a basin plan for hunting and wildlife, it first must be recognized that little can be done to increase hunting opportunities at public facilities such as State fish and game areas since most of them operate at near maximum total capacity. However, increases in hunter use could be accepted on non-peak days and more hunting pressure can be applied to National and State forests. It should also be recognized that 97 percent of all basin hunting occurs on private land.

Considering the foregoing management, developmental and preservation programs are included in the wildlife plan. Programs must be directed to the landowner, educating him on the need for wildlife and on methods of maintaining adequate habitat; commensurate with this, the hunter must be educated to respect personal property and property rights. Essentially, the task of developing small game resources to meet the demand lies primarily with the landowner, particularly farmers. Squirrels and cottontail rabbits, the most abundant of small game, are prevalent in part, because of the type and pattern of land use. Applicable land treatment practices and measures, that are included in the plan, are as follows: 1) ponds constructed and stocked with game fish, fenced and adjacent areas developed for wildlife resting and winter cover; 2) grass waterways; 3) pasture planting; 4) livestock exclusion from treatment areas. The projected hunting demand, supply and needs are illustrated in table 65.

Navigation

The current Cross Wabash Waterway Study is examining the feasibility of canalizing all or parts of the Wabash River from the mouth to the Great Lakes. In this study the Corps of Engineers' initial study effort has been a plan of improvement between the mouth of the river and Terre Haute. Cutoffs and other alignment changes could reduce the effective channel length from 180 to 130 miles. Economic studies are not complete, but there are indications that coal and grain could be the major items of

traffic. The impact of the waterway on the Comprehensive Plan is addressed later in Section VIII – Effects of the Plan. It is for note here that the mainstem area of the Wabash, unlike many other of our country's rivers, lost all but a few remnants of its forests – cypress, sycamore and tulip trees, often six to eight feet in diameter and occasionally exceeded twelve feet – during the era of the early settlers. Conceptually and environmentally considered, a future navigation project, if feasible, may provide a key to partial restoration of this lost heritage rather than its demise.

TABLE 65

HUNTING DEMAND, SUPPLY AND NEEDS

Economic Subarea	Year	Demand	Supply	Needs
		(Thousands of Hunter Days)		
1	1980	905.5	748.6	156.9
	2000	1,051.4	744.1	307.3
	2020	1,131.5	736.8	394.7
2	1980	1,175.2	719.6	455.6
	2000	1,083.1	691.2	391.9
	2020	943.3	688.3	255.0
3	1980	254.0	236.9	17.1
	2000	280.2	234.5	45.7
	2020	304.3	232.1	72.2
4	1980	781.0	601.9	179.1
	2000	848.0	596.0	252.0
	2020	904.9	590.2	314.7
5	1980	328.0	250.3	77.7
	2000	354.8	247.6	107.2
	2020	373.5	246.2	127.3
6	1980	983.7	513.0	470.7
	2000	1,097.7	548.0	549.7
	2020	1,131.6	486.4	645.2
TOTAL	1980	4,427.4	3,070.3	1,357.1
	2000	4,715.2	3,011.4	1,703.8
	2020	4,789.1	2,980.0	1,809.1

DEVELOPMENT OF ENVIRONMENTAL MODIFICATIONS

For centuries upon centuries the needs for long range environmental planning has been apparent to leaders in many fields. In the past their persistent warnings have largely gone unheeded with the result that the productive capacity, habitability and beauty of large areas of the earth have been abused and destroyed. The greatest impact of man on the natural environment has been, and will be, his expanding numbers attended by increasing demands on natural resources and living space. Thus, at a time when the people of the basin, as well as all Americans, are beginning to realize widely the seriousness of environmental problems, it is desirable to consider what should be the additional program to supplement and strengthen the comprehensive plan thus developed.

Perhaps the greatest goal toward this end is one of preserving the highest possible quality of environment for future generations. To achieve this, it becomes a planning obligation to carefully weigh the impacts of proposed development on the multifaceted environment. Where possible, the resources must be carefully enhanced, preserved and managed to prolong their natural quality.

The Wabash Valley has spectacular opportunities and potential for both preservation and development features in the interest of our environmental goal. In the development of the National Income Efficiency Plan which preceded this formulation section, the physical potential of the various developmental features was discussed. Coincident with these features, it must be recognized that for meeting environmental needs in the future, the Basin's potential can be tapped with other framework features: 1) clean its waters; 2) protect its streams with environmental corridors; 3) preserve designated fishery streams; 4) institute land use plans and controls throughout the basin; 5) pursue a reservoir and small watershed regulation study for a balance of goals, particularly the aquatic biology of the basin streams; 6) utilize surface water in mined areas for additional recreation supply; 7) along with the land use plan, give adequate protection and interpretation to the natural, historic and archaeological landmarks. These latter features are discussed in further detail in the paragraphs of the next section, as they are considered on a judgment basis to offer the most significant steps toward the basic environmental objective encom-

passing the conservation, preservation, creation and restoration of the Basin's resources.

DEVELOPMENT OF THE REGIONAL AND SOCIAL MODIFICATIONS

Although the objective of regional development is quite clear, as spelled out in the various water resource planning documents, the specific role of water development in fostering regional development has not, as yet, been defined with precision. Further, means for quantitatively evaluating the benefits accruing from economic expansion are largely lacking for a region such as the Wabash, where areas of inequity are an exception rather than the rule.

Traditional evaluation procedures have been based either on observed market prices for inputs to, and outputs from water resource projects, or from simulated market evaluations. With regional economic development, various representative evaluation methods have been introduced because of the failure of the market system to operate with full effectiveness in a region. Characteristic of some areas of the Wabash Region are diverging market prices and social costs which result in a distortion in the allocation of resources. Pockets of involuntary low income, of under and unemployment, within an area economy exhibiting relatively high employment, demonstrate the presence of such distortion. Thus some correction of observed market values is desirable in these circumstances.

Although the above theory is accurate and the facts of inequity in the region are a matter of record, consideration of alternative water resource solutions relating to regional development, in the same manner that other alternative solutions for, say, water supply problems are considered, is hardly reasonable in the case at hand. It would appear, then, appropriate to view the Comprehensive Plan contribution of water and related land resources development to regional enhancement as the best establishment of a physical environment favorable to subarea and regional expansion with some judgment additions.

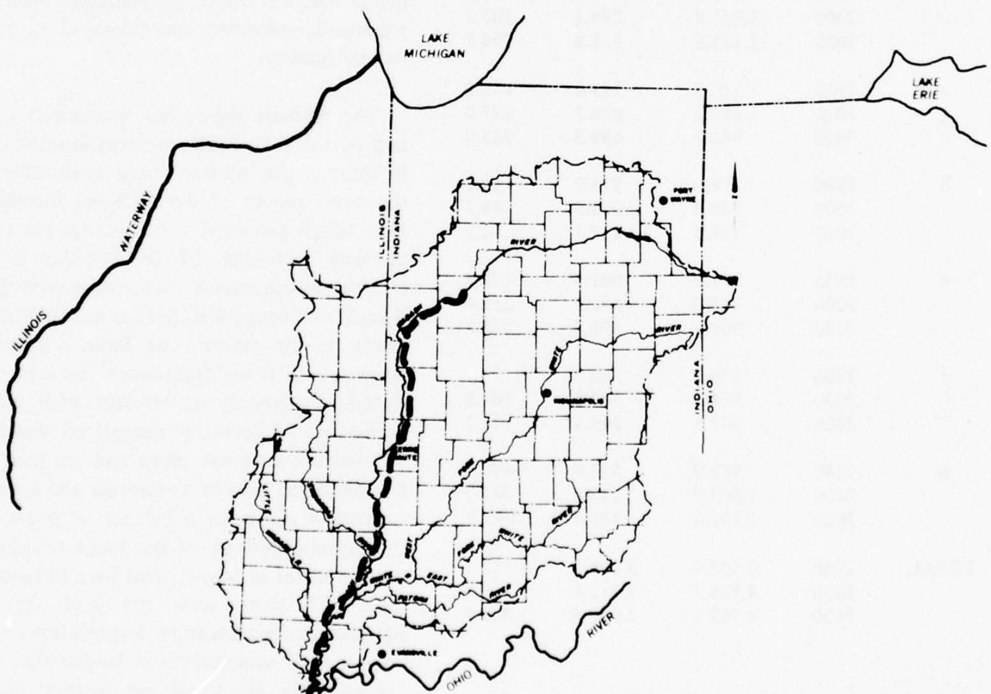


FIGURE 96
POTENTIAL SCENIC PARKWAY

In reviewing all of the developmental and environmental plans for the Wabash Valley, the important environmental corridors and stream preservation features, discussed later, and the reservoirs, watersheds and management measures discussed earlier, there appeared to be some crying need to tie a bank between all interests – national income, regional, environmental and social. Considering the several methods of accomplishing this, as well as other needs of the regions, several development elements have significant potential – three areas for new city development; three power development areas, a 212 mile scenic parkway from Old Shawneetown, Illinois to Lafayette, Indiana with a trail system; and four local protection projects. The first two items would be proposed for study in the Early Action Plan; the remaining items are proposed for development at this time and are costed thus.

As the population of the basin increases from the present 3,500,000 to some 6,500,000 (projected to the year 2020) it becomes imperative that population numbers and distribution be brought in close harmony with the available land and resource base. As the population doubles new cities and power development areas will develop of necessity. These increments of our future destiny need to be planned now.

The scenic parkway would connect all of the natural hydrologic areas, it could provide the region with open space of high scenic and recreation value. There are no scenic parkways of the type suggested in the basin. The Wabash itself suggests a quality route for a parkway. Such a parkway could provide significant recreation in and of itself, and would help to conserve the Illinois and Indiana banks of the river. As envisioned, it would not violate the riverside by following it too closely, but it would be sufficiently related to the Wabash to offer frequent views of the river and to secure, within the right-of-way, the preservation of the rivershore in its natural condition for proper protection and designated recreational use.

Along with the scenic parkway, there is abundant opportunity to develop a Wabash Trail – through the cities, their developing suburbs, and in the country particularly. The trail could be segmented or zoned near the cities to accommodate the casual stroller, the hiker, the horseback rider and the cyclist. Lands or easements which the public needs to insure public passage along the trail would necessarily vary depending on the purpose of a trail segment and surrounding land use.

Local protection projects in the regional segment are treated in the Flood Control paragraph of this section. Basically, the four units proposed as a part of the comprehensive plan have benefit-cost ratios less than unity, but in view of the agricultural growth in the areas as reflected by the present land clearing program, these units have been considered a part of the Regional Plan.

FIGURE 97. PLANNING FOR THE FUTURE WILL SERVE TO PREVENT THE CATASTROPHIC MISFORTUNES OF THE PAST

SECTION VII – THE COMPREHENSIVE BASIN PLAN

PART I – GENERAL DESCRIPTION OF THE PLAN

This section, Section VII, presents detailed information concerning the Comprehensive Basin Plan and the subbasin segments. Part I of this section considers the study area generally and presents the general plan proposed by the Coordinating Committee and information on costs and benefits. In Part II, the individual plan elements, structural and non-structural, are described for both Early Action and Long Range Plans. Part III considers, respectively, the portions of the study area in or associated with the individual subbasins of the Patoka, East Fork, West Fork, Upper Wabash, Middle Wabash, Embarras, Little Wabash and Lower Wabash. Financial data for the Comprehensive Plan is summarized in table 66 . Features of the plan are summarized in table 67 and illustrated in figures 98 and 99.

The plan proposed by the Coordinating Committee provides for development and preservation of the land and water resources to meet the projected uses of the Study Area during the next 50 years. During the formulation period, the plan was developed to provide the best use, or combination of uses, of water in related land resources, to meet all foreseeable short- and long-term needs, and it should be considered in this perspective. It provides for flood control, municipal and industrial water supply, water quality control, land treatment, irrigation and environmental resources including general outdoor recreation, fish and wildlife conservation, general project beautifications and the preservation of historical, scenic, archaeological and scientific resources.

Individual elements of the plan have not been studied in the detail necessary to establish design or construction plans or indeed, even seek authorization for construction. Accordingly, while the plan is only one way in which the regions resources may be development and preserved, it is, in the view of the Coordinating Committee, the soundest approach for accomplishing the basic study objectives on the basis of present knowledge and foreseeable events. Each of the plan elements must be studied in greater detail prior to seeking agency authorization actions. Adjustments in the plan to best serve the overall needs should be worked out in the detailed studies considering the circumstances which prevail at the time.

Some similarities exist among all of the subbasin segments in resource capabilities and opportunities; differences are also quite apparent. Equally obvious are intrasubbasin differences resulting from geologic and economic patterns. Two of the subbasins, West Fork and Middle Wabash, have about 25 percent of the Basin's land area and 50 percent of the population. These subbasins have the major electric generating plants within their boundaries. Together, these two subbasins embrace all or part of the region's six Standard Metropolitan Statistical Areas. Each of the subbasins has extensive agricultural lands; about 64 percent of the Wabash Basin's land is agricultural. All have resources with potentials for developing and preserving environmental resources. Each of the subbasins has resource related problems to face now and in the future. All share, to some extent, the problems attending the prolonged shift from rural to urban - industrial emphasis in the economy.

The thirteen appendixes to this report contain the supporting data for the following plan elements and subbasin plan summaries.

Looking beyond the plan elements and subbasin plan summaries, the Coordinating Committee members fully realize the burden the Comprehensive Basin Plan places upon regional and national financial resources. A look at the past rates of investment in water resources restoration and development, and the present level of financing of needed measures, clearly points to the difficult decisions of priority that must be made. The Committee members and planning staff do not wish to make implied judgments on priorities by further deferring or eliminating projects and programs now in the recommended plan. Instead, the Committee members, guided by the public interest and the stated and implied will of those citizens served by the public interest and implied will of those citizens served by the Wabash, have outlined those measures which will be clearly required if the identified needs are to be met in an orderly fashion within the projection period.

STRUCTURAL MEASURES

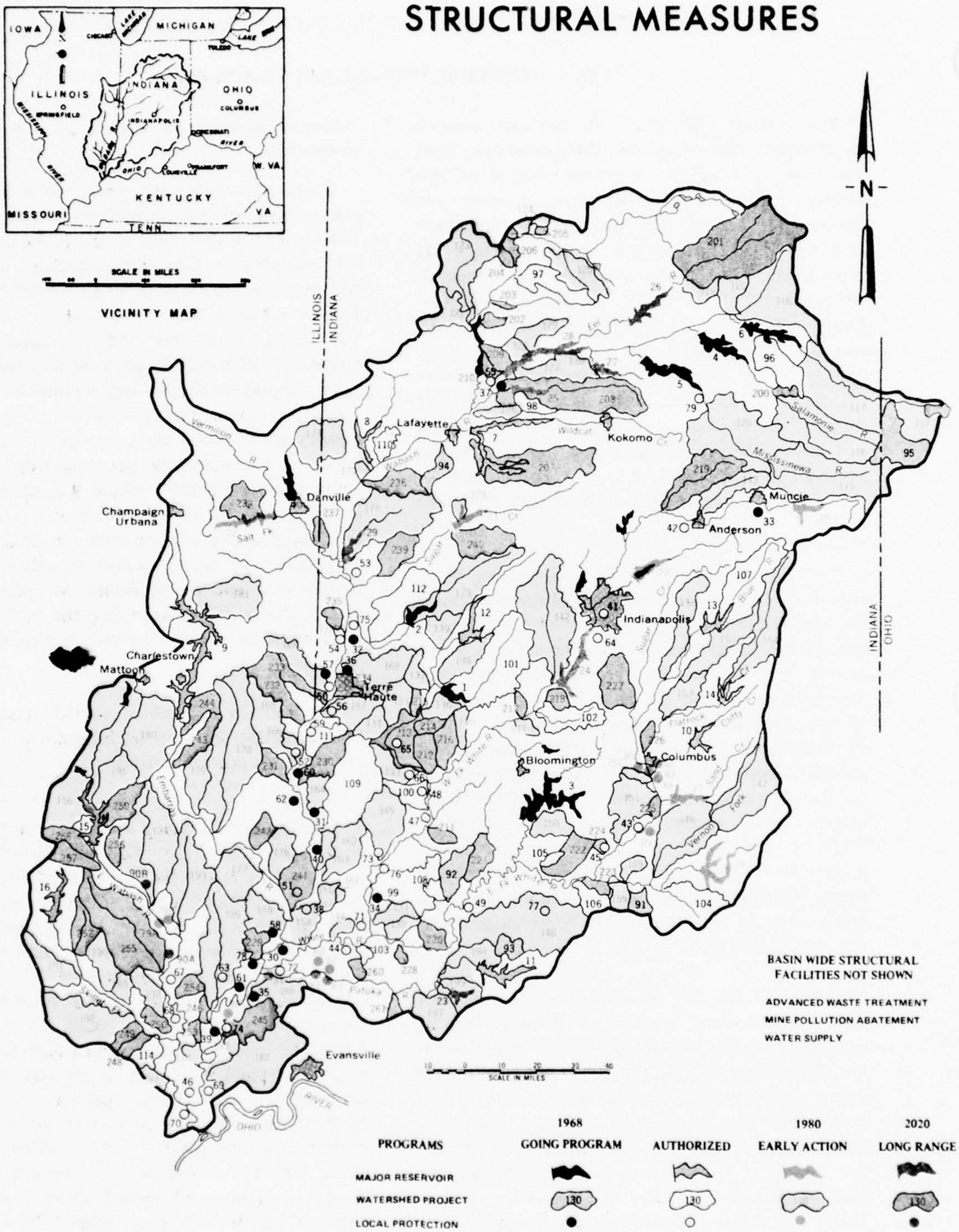


FIGURE 98

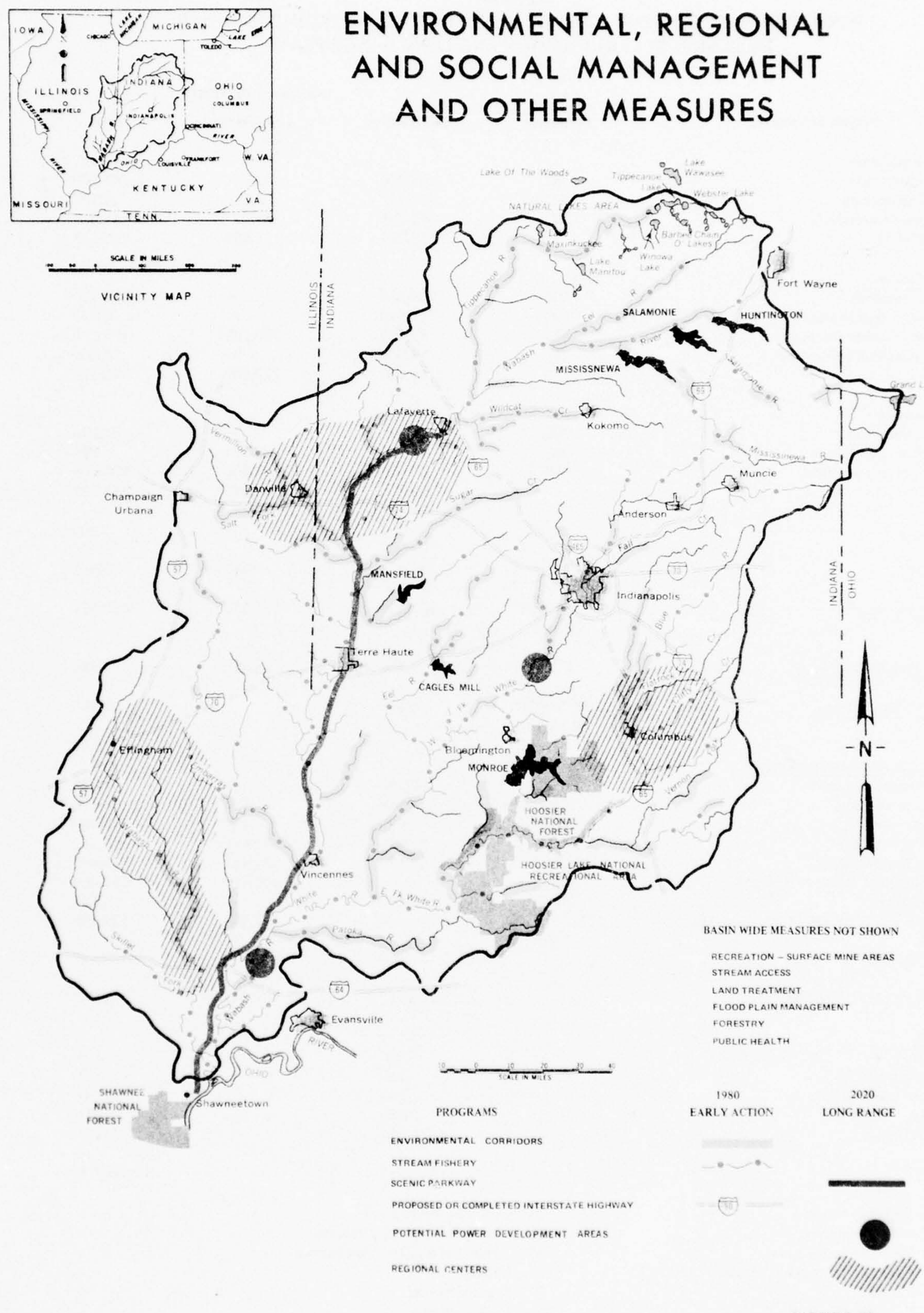

ENVIRONMENTAL, REGIONAL AND SOCIAL MANAGEMENT AND OTHER MEASURES
IOWA
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
MISSOURI
TENN.
W. VA.
VA
SCALE IN MILES
VICINITY MAP
Lake Of The Woods
Tippecanoe Lake
Lake Wawasee
Webster Lake
NATURAL LAKES AREA
Maxinkuckee
Lake Manitou
Winona Lake
Barbee Chain O' Lakes
Fort Wayne
SALAMONIE
HUNTINGTON
MISSISSNEWA
Kokomo
Lafayette
Champaign Urbana
Danville
Muncie
Anderson
MANSFIELD
Indianapolis
Terre Haute
CAGLES MILL
Bloomington
MONROE
Columbus
Effingham
HOOSIER NATIONAL FOREST
HOOSIER LAKE NATIONAL RECREATIONAL AREA
Vincennes
Evansville
SHAWNEE NATIONAL FOREST
Shawneetown
ILLINOIS
INDIANA
INDIANA
OHIO
N
BASIN WIDE MEASURES NOT SHOWN
RECREATION – SURFACE MINE AREAS
STREAM ACCESS
LAND TREATMENT
FLOOD PLAIN MANAGEMENT
FORESTRY
PUBLIC HEALTH
SCALE IN MILES
PROGRAMS
1980 EARLY ACTION
2020 LONG RANGE
ENVIRONMENTAL CORRIDORS
STREAM FISHERY
SCENIC PARKWAY
PROPOSED OR COMPLETED INTERSTATE HIGHWAY
POTENTIAL POWER DEVELOPMENT AREAS
REGIONAL CENTERS

FIGURE 99

TABLE 66

SUMMARIZED INVESTMENT COSTS OF PLAN FEATURES RECOMMENDED FOR INCLUSION IN EARLY ACTION AND LONG RANGE PLANS

Project or Program	Purpose 1/	Investment ($1,000) Early Action	Long Range	Total
Flood Protection				
Major reservoirs	FC	104,200	143,000	247,200
Local protection	FC	13,267	2,910	16,177
Upstream watersheds	FC	118,098	29,987	148,085
SUBTOTAL		235,565	175,897	411,462
Water Quality				
Major reservoirs	WQ	64,800	—	64,800
Upstream watersheds	WQ	7,050	—	7,050
Advanced waste treatment	WQ	72,470	120,000	192,470
Mine pollution abatement	P	10,000	—	10,000
SUBTOTAL		154,320	120,000	247,320
Water Supply				
Major reservoirs	WS	25,000	—	25,500
Upstream watersheds	WS	6,106	181	6,287
Municipal installations	WS	20,600	181,000	201,600
SUBTOTAL		52,206	181,181	233,387
Irrigation	I	230	—	230
Drainage	D	14,027	6,985	21,012
Land Treatment	SC,WQ,FC R,FW	288,229	124,295	412,524
Flood Plain Management	FC,E	1,780	3,310	5,090
Foresty Conservation	FC,WQ,SC, R,FW,T	46,800	—	46,800
Environmental-Regional-Social				
Environmental corridors	R,E,	60,228	—	60,228
Fish and wildlife	FW,E	3,044	1,590	4,634
Stream fishery	F,E,	19,400	3,000	22,400
Major reservoirs	R,E,	21,820	70,420	92,240
Upstream watersheds	R,FW,E	59,500	19,469	78,969
Wabash scenic parkway and trail	T,R,E	—	150,000	150,000
Access sites	R,E,	3,652	—	3,652
Hoosier Lake National Recreation Area	R,FC,FW F,E	—	117,900	117,900
SUBTOTAL		167,644	362,379	530,023
TOTAL, ALL PURPOSES		960,801	974,047	1,934,848
Studies				
Regional Centers, New Cities, Power		7,000	—	7,000
Grand Lake Studies		250	—	250
Reservoir Regulation		1,500	—	1,500
Land use		6,000	—	6,000
SUBTOTAL		13,250		13,250
TOTAL		974,051	974,047	1,948,098

1/ FC – Flood Control
WQ – Water Quality
WS – Water Supply
P – Pollution Abatement - Mines
I – Irrigation
D – Drainage
SC – Soil Conservation
R – General Outdoor Recreation
FW – Fish and Wildlife - Recreation
F – Fishing
T – Transportation
E – Environmental

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL–MANAGEMENT AND OTHER MEASURES

NOTES:
1/ A – Authorized; C – Completed; U – Under Construction; R – Recommended
2/ FC – Flood Control; R – Recreation; WS – Water Supply; WQ – Water Quality; D – Drainage; F&W – Fish and Wildlife; I – Irrigation
3/ Ag – Flood Protection, Agricultural Lands; Ur – Flood Protection, Urban Lands

MAJOR RESERVOIRS

Project Number	Status 1/	Project	River Mile Downstream End	Drainage Area (Sq Mi)	Total Storage (Ac-ft)	Purpose 2/
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
1	C	Cagles Mill	2.8	295	228,100	FC,R
2	C	Mansfield	32.4	216	132,800	FC,R,WQ
3	C	Monroe	25.9	441	441,000	FC,R,WS,WQ
4	C	Salamonie	3.1	553	263,600	FC,R,WQ
5	C	Mississinewa	7.1	809	368,400	FC,R,WQ
6	C	Huntington	411.4	707	153,100	FC,R
7	A	Lafayette	7.2	787	331,880	FC,R,F&W
8	A	Big Pine	2.5	331	210,500	FC,R,F&W
9	A	Lincoln	103.0	915	529,340	FC,R,WS,WQ,F&W
10	A	Clifty Creek	18.4	140	56,370	FC,R,F&W
11	U	Patoka	118.3	168	301,600	FC,R,WS,WQ
12	A	Big Walnut	25.9	197	160,700	FC,R,WS,WQ
13	A	Big Blue	42.1	269	85,700	FC,R,WS,WQ
14	A	Downeyville	41.0	276	86,400	FC,R,WS
15	A	Louisville	164.8	661	148,000	FC,R,WS,WQ
16	A	Helm	71.9	210	112,100	FC,R,WS,WQ
		Subtotal		6,975	3,609,590	
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
17	R	Azalia	3.0	250	69,920	FC,R,F&W
18	R	Deputy	52.5	294	147,000	FC,R,WQ,F&W
19	R	Parker	175.0	175	133,000	FC,R,WQ,F&W
20	R	Fall Creek	17.0	242	223,100	FC,R,WS,WQ,F&W

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL–MANAGEMENT AND OTHER MEASURES (CONTINUED)

Project Number	Status[1/]	Project	River Mile Downstream End	Drainage Area (Sq Mi)	Total Storage (Ac-ft)	Purpose[2/]
21	R	Crawfordsville	44.0	423	161,170	FC,R,WS,WQ,F&W
22	R	Salt Fork	13.0	515	230,000	FC,R,WQ,F&W
		Subtotal		1,899	964,190	
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
23	R	Maltersville	3.0	62	23,200	FC,R,F&W
24	R	Martinsville, Upper	207.0	2,110	420,000	FC,R,F&W
25	R	Deer Creek	4.0	280	90,000	FC,R,F&W
26	R	Denver	25.0	680	263,000	FC,R,F&W
27	R	Pipe Creek	6.5	167	68,800	FC,R,F&W
28	R	Delphi, Upper	334.0	4,136	514,000	FC,R,F&W
29	R	Coal Creek	4.0	256	170,250	FC,R,F&W
		Subtotal		7,691	1,549,250	
		TOTALS, ALL TIME FRAMES		**16,565**	**6,123,030**	

LOCAL PROTECTION PROJECTS

Project Number	Status	Project	River Mile Downstream End	Length (Miles)	Area Benefited (Acres)	Purpose[3/]
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
30	C	Brevoort	104.5	37.1	5,000	Ag
31	C	Gill Township	152.0	12.9	12,000	Ag
32	C	Lyford	227.5	7.8	3,500	Ag
33	C	Muncie	319.0	5.4	50	Ur
34	C	Levee Unit 8	69.0	17.6	13,400	Ag
35	C	Levee Unit 5	58.0	41.9	44,000	Ag,Ur
36	C	Terre Haute	217.5	0.2	110	Ur
37	C	Delphi	330.0	0.6	310	Ur
38	C	Vincennes	128.0	5.2	2,700	Ur

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL–MANAGEMENT AND OTHER MEASURES (CONTINUED)

Project Number	Status	Project	River Mile Downstream End	Length (Miles)	Area Benefited (Acres)	Purpose[3/]
39	C	New Harmony Bridge	51.5	—	—	Bridge Protection
40	C	Niblack	134.8	17.0	15,900	Ag
41	C,A	Indianapolis	232.0	0.9	—	Ur
42	C	Anderson	299.0	1.2	98	Ur
43	A	Levee Unit 5	202.0	28.4	23,000	Ag
44	A	Levee Unit 1	34.8	10.0	7,720	Ag
45	A	Levee Unit 2	189.0	11.3	6,800	Ag
46	A	Levee Units 3&4	16.0	28.2	49,260	Ag
47	A	Levee Unit 9	121.0	0.4	2,220	Ag
48	A	Levee Unit 10	136.0	2.9	2,500	Ag, Ur
49	A	Shoals	107.4	1.6	230	Ur
50	A	Sugar Creek	212.0	3.9	1,340	Ur
51	A	Russell and Allison	123.8	21.6	33,000	Ag
52	A	Levee Unit 6	179.0	14.0	18,900	Ag
53	A	Adams	246.0	4.2	1,400	Ag
54	A	Clinton	229.6	0.5	90	Ur
55	A	Deer Creek Prairie	325.8	3.7	365	Ag
56	A	Honey Creek	200.0	6.0	1,520	Ag
57	U	West Terre Haute	1.2	2.8	440	Ur
58	U	England Pond	118.1	6.0	4,250	Ag
59	A	Greenfield Bayou	188.1	13.7	11,370	Ag
60	U	Island Levee	169.4	9.3	4,660	Ag
61	U	Rochester McCleary's Bluff	80.0	9.1	5,400	Ag
62	U	Tri Pond	161.5	8.4	4,900	Ag
63	A	Bonpas Creek	0–11.2	11.2	(Channel Improvement)	Ag
64	A	Fletcher, Sunshine Gardens	228.5	4.7	1,790	Ag, Ur
65	A	Levee Unit 2	13.0	14.8	24,060	Ag
66	A	Levee Unit 1	7.0	8.2		Ag
67	A	Levee Unit 2	76.4	8.4	7,360	Ag
68	A	Levee Unit 1	45.0	21.5	18,000	Ag
69	A	Levee Unit 2	833	25.2	24,480	Ag
70	A	Levee Unit 1	0.0	14.7	22,030	Ag
71	A	Levee Unit 7	54.0	10.8	7,010	Ag
72	A	Levee Unit 17	2.0 and 4.0	8.9	7,200	Ag
73	A	McGinnis	90.0	4.0	12,600	Ag
74	A	New Harmony	51.0	2.2	295	Ur

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL-MANAGEMENT AND OTHER MEASURES (CONTINUED)

Project Number	Status	Project	River Mile Downstream End	Length (Miles)	Area Benefited (Acres)	Purpose[3/]
75	A	Raccoon	234.5	4.3	1,360	Ag
76	A	Shufflebarger	92.8	13.6	5,280	Ag
77	A	Orleans	58.5	1.7	100	Ur
78	C	Mt. Carmel	93.6	3.3	540	Ur
79	A	Marion	36.7	1.2	107	Ur
		Subtotal			453,645	
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
79a	R	Levee Unit 7	113.5	4.8	2,580	Ag
79b	R	Levee Unit 8	110.0	3.6	1,700	Ag
80	R	Levee Unit 2	24.5	3.3	2,520	Ag
81	R	Levee Unit 3	25.5	6.6	1,930	Ag
82	R	Levee Unit 4	29.0	4.0	1,230	Ag
83	R	Levee Unit 5	32.0	2.7	696	Ag
84	R	Patoka Channel Improvement	0.0	41.5		Ag
85	R	Columbus West Levee	239.0	6.8	2,500	Ag,Ur
86	R	Wiemeyer Levee	3.8	1.2	55	Ur
87	R	Beatty Levee	239.2	4.6	1,100	Ag,Ur
88	R	Levee Unit 5	235.8	4.1	1,830	Ag
89	R	Levee Unit 17	214.1	4.3	1,450	Ag
90	R	Levee Unit 50	51.0	7.2	3,060	Ag
		Subtotal			16,371	
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
90a	R	Levee Unit 3	84.0	9.0	5,260	Ag
90b	R	Levee Unit 9	128.7	6.6	4,220	Ag
		Subtotal			9,480	

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL–MANAGEMENT AND OTHER MEASURES (CONTINUED)

UPSTREAM WATERSHED PROJECTS

Project Number	CNI No	Project	Project Area (Sq Mi)	Structures Number	Structures Total Storage (Ac-ft)	Channel Improvement (Miles)	Purpose
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED							
91		Elk Creek	28.2	7	1,739	14.0	FC,I,D,F&W
92		Boggs Creek	63.8	2	4,799	8.2	FC
93		French Lick Creek	34.2	4	4,461	5.1	FC,F&W
94		Little Wea Creek	18.7	—	—	8.6	FC
95		Upper Wabash	125.8	3	2,471	38.2	FC,D
96		Rock Creek (Wells County)	95.3	—	—	28.8	FC,D
97		Mill Creek (Fulton County)	90.0	—	—	16.3	FC,D
98		Bachelor Run	36.8	—	—	20.6	FC,D
99		Prairie Creek – Daviess	138.6	11	5,220	48.6	FC,R,D
100		Lattas Creek	55.9	—	—	22.4	FC,D
101		Mill Creek	292.4	14	10,128	53.3	FC,R
102		Indian Creek	92.4	10	16,857	—	FC,R
103		Prides Creek	14.4	3	2,353	6.2	FC,R,D
104		Stucker Fork	184.1	16	12,071	25.6	FC
105		Dewitt Creek	14.1	2	863	2.3	FC
106		Twin Rush Creek	43.9	3	8,678	11.0	FC,WS,D
107		Upper Big Blue River	193.8	11	39,475	32.8	FC,WS,WQ,R,D
108		West Boggs Creek	22.1	1	11,174	4.6	FC,R
109		Busseron Creek	236.8	26	39,636	52.9	FC,R,WS
110		Kickapoo Creek	38.6	—	—	9.3	FC,D
111		Prairie Creek – Vigo	29.8	3	2,698	4.9	FC,D
112		Little Raccoon Creek	153.6	17	21,592	43.0	FC,R
113		Scattering Fork	114.3	—	—	37.6	FC,D
114		Seven Mile Creek	35.9	1	2,131	16.2	FC,R,D
		Subtotal	2,153.5	134	186,346	510.5	
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN							
115	17-9	Clear Creek	49.1	N.A.	N.A.	N.A.	FC,D
116	17-8	Little River	286.6	7	24,210	28.4	FC,R,D,WQ
117	17-2-3	Buckeye Hoosier	390.6	4	97,930	57.5	FC,R,WQ,D

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL– MANAGEMENT AND OTHER MEASURES (CONTINUED)

Project Number	CNI No	Project	Project Area (Sq Mi)	Structures Number	Structures Total Storage (Ac-ft)	Channel Improvement (Miles)	Purpose
118	17-12	Salamonie River	260.0	1	1,380	46.0	FC,D,R
119	17b-3	Pony Creek	33.0	—	—	12.8	FC,D,F&W
120	17a-2	Lower Mississinewa	341.0	2	4,700	—	
121	17a-1	Upper Mississinewa	343.0	—	—	20.0	FC,R
122	17c-21	Brown Hill	86.0	—	—	31.5	FC,D
123	17c-20	Big Monon Ditch	167.5	—	—	55.6	FC,D
124	17c-9	House Bartee	28.8	—	—	20.3	FC,D
125	17c-7	Mud Creek	105.0	—	—	38.2	FC,D
126	17-39	Sugar Creek	29.3	—	11,180	10.6	FC,D,R
127	17-33	Rock Creek (Cass)	88.3	1	—	18.4	FC,D
128	17-31	Burnetts Creek	21.7	—	—	9.8	FC,D
129	17-31	Crooked Creek	60.6	—	—	14.5	FC,D
130	17-26	Goose Creek	3.4	3	730	1.0	FC,R
131	17hl-49	Veale Creek	38.3	4	2,200	8.0	FC,R
132	17hl-45	Black Ditch	139.9	2	2,520	37.2	FC,R,D,WQ
133	17hla-14&16	Lagoon Ditch and Wabash and Erie Canal	37.2	—	—	21.0	FC
134	17hla-13	Splunge Creek	44.9	—	N.A.	N.A.	N.A.
135	17hla-11	Birch Creek	66.7	6	12,360	—	FC,WQ
136	17hla-8	Jordan Creek	37.7	4	13,140	—	FC,R
137	17hla-6	Croys Creek	39.7	3	6,380	4.3	FC,R
138	17hla-4	Deer Creek	91.1	1	26,770	—	FC,R
139	17hla-2	Little Walnut	64.4	3	12,735	—	FC,R
140	17hl-30	Rattlesnake Creek	23.7	1	13,540	—	FC,R
141	17hl-25	Bryant Creek	11.4	1	2,590	—	FC,R
142	17hl-20	Whitelick Creek	282.8	7	40,150	—	FC,R,WQ
143	17hl-3	Killbuck Creek	107.4	—	—	29.1	FC,D
144	17h-3	Wilson Creek	17.2	1	4,860	4.0	FC,R,WQ,WS
145	17h2-45	Aikman Creek	34.7	4	2,890	7.0	FC,D
146	17h2-41	Lost River	365.1	11	43,240	44.0	FC,R,WS
147	17h2b-1	Upper Vernon Fork	196.0	5	104,380	—	FC,R,WS,WQ
148	17h2b-2	Lower Vernon Fork	217.2	13	26,070	64.0	FC,R,D,F&W
149	17h2b-7	Pond Creek	25.7	2	6,020	9.9	FC,R,D
150	17h2-33	Little Salt Creek	53.7	3	5,860	—	FC
151	17h2-15	White Creek and Beatty Walker	130.5	14	30,160	39.1	FC,R,D
152	17h2-10	Denios Creek	17.9	3	5,300	—	FC,R
153	17h2-5	Lewis Creek	81.0	—	—	27.5	FC,D
154	17h2-1	Upper Big Flatrock River	295.8	—	11,990	52.1	FC,WS,F&W,D

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL-MANAGEMENT AND OTHER MEASURES (CONTINUED)

Project Number	CNI Ni	Project	Project Area (Sq Mi)	Structures Number	Structures Total Storage (Ac-ft)	Channel Improvement (Miles)	Purpose
155	17h2b-8	Delaney Creek	34.2	5	3,800	8.5	FC,R,I
156	17h2a-4	Brandywine Creek	108.0	—	—	26.2	FC,D
157	17h2a-3	Little Blue River	105.8	1	16,860	13.1	FC
158	17-105	Vieke Ditch	49.9	—	—	13.2	FC,D
159	17-107	Raccoon Creek (Illinois)	77.3	—	—	18.9	FC,D
160	17-103	City Ditch	15.9	—	—	10.8	FC,D
161	17-103	Snapp-Kelso	24.3	1	2,950	—	FC,R
162	17-102	Mariah Creek	105.1	2	2,450	20.7	FC,R,D
163	17-101	Lower Shaker Prairie	25.0	—	—	10.1	FC,D
164	17-93	Turtle Creek	38.3	8	6,470	10.0	FC,R,I
165	17-87	Mill Creek (Illinois)	127.9	8	35,590	39.4	FC,R
166	17-85	Snyder Creek (Illinois)	16.9	1	2,000	5.1	FC
167	17-77	Honey Creek	95.8	8	8,580	17.6	FC,R
168	17-75	Sugar Creek (Illinois)	96.6	2	37,720	—	FC,WS,WQ
169	17-71	Otter Creek	126.4	5	20,540	7.0	FC,R
170	17-55	Coal Creek	263.8	2	23,450	—	FC,R
171	17-51	Fall Creek	7.6	1	1,310	—	FC,R
172	17-68	Feather Creek	8.1	1	5,170	0.5	FC,R
173	17-62	Big Raccoon Creek	208.0	8	24,220	14.8	FC,R,FW
174	17e-7	Jordan Creek	114.1	—	—	24.6	FC,D
175	17f-3	Lye Creek	77.8	—	—	42.9	FC,D
176	17g-3,4	Brushy-Birch Creek	65.9	5	7,540	17.5	FC,R,WQ
177	17g-5	Muddy Creek	100.9	2	4,490	18.0	FC,D,WQ
178	17g-11	North Fork Embarras River	356.8	12	62,010	56.4	FC,R,WQ,WS
179	17g-12	Crooked Creek	77.9	5	15,440	12.1	FC,R
180	17g-21	Muddy Creek	215.5	6	51,450	—	FC,R,WS,WQ
181	17g-33	Brushy Creek	56.6	—	—	17.0	FC
182	17-125	Big Creek	254.4	10	30,845	25.7	FC,R,D
183	17-121	Gresham Creek	15.9	13	6,485	9.8	FC,R,D
184	17-123	McHenry-Hawthorne	N.A.	N.A.	N.A.	N.A.	N.A.
185	17-113	Scott Ditch and Coffee Bayou	80.2	3	11.735	38.0	FC.R.D
186	17-117	Bonpas Creek	270.6	9	26,245	54.0	FC,R,WQ,WS,D
187	17j-2	Lick Creek	19.8	2	4,370	5.1	FC,R
188	17hl-12	Auxier-Big Creek	226.0	4	13,300	7.5	FC,R,WS,D
189	17hl-14	Big Mound	35.9	1	1,310	11.7	FC,D
190	17jl-15	Dry Fork	78.8	4	18,870	9.1	FC,R,WS
191	17jl-18	Horse Creek	108.3	5	23,000	21.3	FC,R,WS

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL–MANAGEMENT AND OTHER MEASURES (CONTINUED)

Project Number	CNI No	Project	Project Area (Sq Mi)	Structures Number	Structures Total Storage (Ac-ft)	Channel Improvement (Miles)	Purpose
192	17j-28,29	Pond Creek	53.9	1	2,700	11.0	FC,R
193	17j-39	Fox River	195.2	5	37,110	36.3	FC,R,WS,WQ
194	17j-42	Big Muddy Creek	312.0	7	42,660	22.7	FC,R
195	17j-51	Salt Creek	93.7	4	22,790	5.9	FC,R
196	17j-52	Upper Little Wabash River	377.0	7	49,060	9.1	FC,WQ,WS
197	17i-6	Hunley-Ell	100.6	8	30,320	33.3	FC,R,WQ,WS
198	17i-3	Upper Patoka River	111.8	5	3,780	—	FC,WS,WQ
199	17i-4	Hall-Flat Creek	68.0	8	10,935	19.0	FC,R,WQ,WS
		Subtotal	9,716.7	287	1,132,840	1,435.7	
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN							
200	17-14	Scuffle Creek	14.1	—	—	7.2	FC,D
201	17b-1	Eel River	380.7	1	1,260	122.0	FC
202	17c-19	Timmons Ditch	10.7	—	—	9.9	FC,D
203	17c-18	Ackerman Ditch	9.1	—	—	6.3	FC,D
204	17c-11	Quigley Marsh	14.0	—	—	6.0	FC,D
205	17c-9	Fell-Taylor Ditch	4.4	—	—	3.5	FC,D
206	17c-8	Chapman Creek	3.4	—	—	3.0	FC,D
207	17d-2	South Fork Wildcat Creek	242.0	—	—	16.8	FC,D
208	17-36	Deer Creek	338.4	—	—	95.5	FC,D
209	17-34	Pleasant Run Creek	12.6	—	—	2.7	FC,D
210	17-34	Rattlesnake Creek	29.3	—	—	13.7	FC,D
211	17hl-40	Doans Creek	26.6	2	6,320	—	FC,R
212	17hla-17	Lick Creek	55.2	6	13,750	—	FC,R
213	17hla-15	Pond Creek	4.4	—	—	2.7	FC
214	17hla-10	Six Mile Creek	26.8	5	4,890	3.2	FC,R
215	17hla-7,9	Hog-McIntyre	17.4	2	4,160	—	FC,R
216	17hl-32	Fish Creek	58.2	6	26,270	—	FC,R
217	17hl-24	Burkhart Creek	7.1	1	3,470	—	FC,R
218	17hl-19	Clear Creek	23.0	1	3,550	—	FC.R
219	17hl-5	Pipe Creek	N.A.	N.A.	N.A.	N.A.	FC,R
220	17h2-40	Sugar and Slate Creeks	36.9	6	8,160	—	FC,R
221	17h2-34	Sulphur Creek	169.7	1	7,710	—	FC,R
222	17h2-24	Gutherie	96.6	3	21,580	—	FC,R,WS
223	17h2-20	Buffalo Creek	16.6	2	8,180	—	FC,R

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL-MANAGEMENT AND OTHER MEASURES (CONTINUED)

Project Number	CNI No	Project	Project Area (Sq Mi)	Structures Number	Structures Total Storage (Ac-ft)	Channel Improvement (Miles)	Purpose
224	17h2-17	McHargue Creek	8.4	1	220	2.5	FC,D
225	17h2-13	John Thompson Ditch	11.8	—	—	7.3	FC
226	17h2-6	Big Slough	15.9	—	—	9.4	FC
227	17h2-6	Youngs Creek	108.3	2	1,260	12.6	FC
228	17h2-44	Bear Creek	6.5	1	3,410	—	FC,R
229	17-110	Crawfish Creek	34.5	—	—	15.3	FC,D
230	17-91	Turman Creek	90.0	2	9,510	—	FC
231	17-88	Raccoon Creek (Illinois)	42.4	2	9,660	4.2	FC,R
232	17-82	Big Creek (Illinois)	108.3	4	25,990	—	FC,R
233	17-76	Clear Creek (Illinois)	43.3	2	20,300	—	FC,R
234	17-73	Lost Creek	26.7	1	1,440	4.4	FC
235	17-68	Norton Creek	24.7	2	7,950	—	FC,R
236	17-52	Big Shawnee Creek	64.4	—	—	24.1	FC,D
237	17e-3	Cole Branch	16.0	1	3,090	—	FC
238	17e-11	Stony Creek (Illinois)	72.0	—	—	16.5	FC,D
239	17f-10	Sugar Mill	92.3	3	10,430	—	FC,R
240	17f-5	Little Sugar Creek	93.7	—	—	8.3	FC,D
241	17g-2,41,42	Otter-Beaver-Allison	82.0	—	—	38.2	FC,D
242	17g-7	Honey Creek	38.0	2	6,130	7.6	FC,R
243	17g-20	Range Creek	58.5	3	13,530	—	FC,R
244	17g-23	Hurricane Creek	57.1	2	12,070	—	FC
245	17-120	Black River	100.2	4	2,990	26.8	FC,R
246	17-118	French Creek	21.2	2	8,610	7.2	FC,R
247	17jl-6	Limekiln Creek	13.1	—	—	4.8	FC,D
248	17jl-8	Lost Creek	30.8	2	1,500	—	FC
249	17jl-9	Beaver Creek	24.6	—	—	7.9	FC
250	17jl-10	Prairie Creek	13.6	—	—	4.9	FC,D
251	17jl-11	Nameless Creek	6.0	1	1,740	—	FC,WS
252	17jl-21	Brush Creek	57.4	2	7,300	10.2	FC
253	17j-24	Elliott Creek	13.1	—	—	2.3	FC
254	17j-27	Big Creek	34.3	—	—	18.8	FC
255	17j-34	Elm River	276.7	13	74,400	30.8	FC,R
256	17j-44	Panther Creek	30.3	2	2,330	7.5	FC
257	17j-45	Crooked Creek	46.6	1	8,880	—	FC
258	17j-46	Dismal Creek	52.0	1	11,630	—	FC
259	17j-50	Bishop Creek	66.6	2	10,700	—	FC,WS
260	17i-12	Flat Creek	13.5	1	1,700	—	FC,WS

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL-MANAGEMENT AND OTHER MEASURES (CONTINUED)

Project Number	CNI No	Project	Project Area (Sq Mi)	Structures Number	Structures Total Storage (Ac-ft)	Channel Improvement (Miles)	Purpose
261	17i-9	Cup Creek	18.2	2	2,340	3.3	FC,R,WS
		Subtotal	3,510.2	97	368,410	567.4	
		TOTAL, ALL TIME FRAMES	15,380.4	518	1,687,596	2,513.6	

ADVANCED WASTE TREATMENT

Item	Patoka	East Fork	West Fork	Upper Wabash	Middle Wabash	Embarras	Little Wabash	Lower Wabash	Total
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN									
Number of Communities	3	18	28	17	17	14	15	—	112
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN									
Number of Communities	2	9	15	24	14	—	—	—	64

COAL MINE DRAINAGE POLLUTION ABATEMENT

Area	Remarks
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN	
Patoka Subbasin	Located in South Fork Patoka River – About 4,000 Acres.
Middle Wabash	Located in Busseron Creek – About 1,920 Acres.

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL–MANAGEMENT AND OTHER MEASURES (CONTINUED)

WATER SUPPLY

Item	Patoka	East Fork	West Fork	Upper Wabash	Middle Wabash	Embarras	Little Wabash	Lower Wabash	Total
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN									
Number of Communities	6	15	11	12	13	4	7	2	70
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN									
Number of Communities	7	31	42	49	32	13	11	5	190

LAND TREATMENT

Economic Subarea	Cropland	Pasture	Forest (1,000 Acres)	Urban	Other	Total
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
1. East Fork White and Patoka	895	240	277	56	54	1,522
2. West Fork White	1,350	201	160	84	60	1,855
3. Little Wabash	594	96	61	6	[illegible]	771
4. Embarras and Middle Wabash	1,105	106	54	15	23	1,303
5. Middle Wabash	572	76	60	6	12	726
6. Upper Wabash	1,940	182	68	49	45	2,284
TOTAL	**6,456**	**901**	**680**	**216**	**208**	**8,461**
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
1. East Fork White and Patoka	420	120	490	186	26	1,242

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL–MANAGEMENT AND OTHER MEASURES (CONTINUED)

Economic Subarea	Cropland	Pasture	Forest (1,000 Acres)	Urban	Other	Total
2. West Fork White	500	41	259	316	24	1,140
3. Little Wabash	216	34	92	36	5	383
4. Embarras and Middle Wabash	405	40	93	78	10	626
5. Middle Wabash	298	46	115	30	7	496
6. Upper Wabash	840	68	93	177	23	1,201
TOTAL	**2,679**	**349**	**1,142**	**823**	**95**	**5,088**

COMMUNITIES WITH POTENTIAL NEED
FOR FLOOD PLAIN MANAGEMENT SERVICES

Item	Patoka	East Fork	West Fork	Upper Wabash	Middle Wabash	Embarras	Little Wabash	Lower Wabash	Total
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN									
Number of Communities	4	14	10	9	8	3	4	2	54
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN									
Number of Communities	1	9	15	11	11	6	7	1	61

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL–MANAGEMENT AND OTHER MEASURES (CONTINUED)

ENVIRONMENTAL CORRIDORS AND ACCESS AREAS

Economic Subarea	Length (Miles)	No of Access Sites	Area of Access Sites (Acres)	Land Acquisition or Lease along Stream (Acres)
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN				
1. East Fork White and Patoka	406	20	1,000	24,240
2. West Fork White	232	13	650	11,580
3. Little Wabash	109	5	250	6,540
4. Embarras and Middle Wabash	186	10	500	8,760
5. Middle Wabash	251	12	600	14,980
6. Upper Wabash	460	23	1,150	27,530
TOTAL	**1,644**	**83**	**4,150**	**93,630**

STREAM FISHERY PRESERVATION AND ACCESS AREAS

Economic Subarea	Length	No of Sites	Potential Area (Land and Water) Related to Access
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN			
1. East Fork White and Patoka	597	296	7,130
2. West Fork White	837	418	9,990
3. Little Wabash	260	126	3,110
4. Embarras and Middle Wabash	564	278	6,770

TABLE 67

WABASH RIVER BASIN COMPREHENSIVE WATER RESOURCES PROGRAM
DATA ON STRUCTURAL, ENVIRONMENTAL, REGIONAL, SOCIAL–MANAGEMENT AND OTHER MEASURES (CONTINUED)

Economic Subarea	Length	No of Sites	Potential Area (Land and Water) Related to Access
5. Middle Wabash	367	182	4,210
6. Upper Wabash	634	304	7,580
TOTAL	**3,259**	**1,604**	**38,790**

PARKWAY, TRAIL AND HOOSIER LAKE NATIONAL RECREATION AREA

Item	Remarks
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN	
Wabash Parkway	Would have a length of 300 miles and extend from Old Shawneetown, Illinois to Lafayette, Indiana
Trail System	Would be built along with the Parkway and extend over the entire distance.
Hoosier Lake National Recreation Area	Would be located in the rolling hills of Lawrence, Orange, Washington and Jackson Counties, Indiana It would encompass an area of 67,000 acres.

PART II – DESCRIPTION OF PLAN FEATURES

GENERAL FEATURES

The comprehensive plan developed for the Wabash River basin includes the existing and under construction water resources and related land improvement facilities in the basin, and those additional improvements required to meet near term and long range and related land resource needs to the maximum practical extent. The additional improvements are separated into the categories of:

Those recommended for inclusion in an early action plan of construction

Those recommended for inclusion in a long range plan for future planning

General data on structural measures that constitute the comprehensive plan have been previously given in table 67 and illustrated in figure 98.

In addition to the structural measures listed in the aforementioned table, other measures include: environmental corridors; stream fishery preservation; access areas; environmental measures provided by major reservoirs and upstream watershed projects; flood plain management; reservoir and stream regulation studies to enable project operations commensurate with the aquatic environment; use of surface mined lands for recreation; land use study which among other features would formulate land use regulation and development to preserve or conserve the natural, historical, archeological and cultural features; encourage clean waters; land treatment; and a scenic parkway and trail system.

The projects and programs of the early action portion of the proposed plan of improvement would satisfy the urgent needs for additional flood protection, water supply, water quality control, land treatment and management, and environmental resources including recreation and fish and wildlife enhancement in the Wabash River basin; stimulate the economic growth in the region; and provide for the preservation of valuable environmental features. The projects and programs in the long range plan for future planning would permit a full and orderly development of the basin's water and related land resources as the need arises within the projection period. A resume of the plan features and programs included in the comprehensive plan is presented in the following paragraphs.

EARLY ACTION – STRUCTURAL MEASURES

Structural measures included in the early action portion of the comprehensive plan consist of:

Six major reservoir projects

Eighty-seven upstream watershed projects with 287 structures - 75 would have recreation developments with a capability of over 6,000,000 visitor days; 37 would have municipal and industrial water supply storage and water quality storage, totaling over 103,000 acre feet.

Water quality measures, including advanced waste treatment; low flow augmentation; and coal mine abatement measures

Municipal and industrial supply measures, including ground water development

Local flood protection projects consisting of channel improvements, levees, and floodwalls in different combinations

Major Reservoirs

The six major reservoirs, Azalia, Deputy, Parker, Fall Creek, Crawfordsville and Salt Fork, would operate with the existing, under construction and authorized projects as a flood control system, controlling approximately 29 percent of the drainage area above the mouth of the river. The system would provide a high degree of protection in the tributary areas, both urban and rural in which the projects are located and somewhat less protection at downstream locations along the main stem. Conservation storage would be provided as required to help meet water supply and water quality needs. Recreation and fish and wildlife measures at all major reservoir projects are considered for the optimum, practical contribution to the environmental resource base. Detailed data on the projects are given in Attachment 1 of this report and Appendix L – Project Engineering Studies, Appendix H – Agriculture, Appendix F – Water Use and Stream Quality.

Azalia Reservoir would be located on Sand Creek, a tributary of East Fork White River, in Bartholomew, Jackson, and Jennings Counties, Indiana. The damsite is about 2.5 miles southeast of the town of Azalia, Indiana. The project would control 250 square miles or 97 percent of the total 259 square mile drainage basin of Sand Creek. As presently planned, Azalia Reservoir would provide storage for flood control and recreational purposes, and it would have additional storage capability if future conditions indicate a need for such storage.

Deputy Reservoir would be located on East Fork Muscatatuck River, a tributary to East Fork White River in Jefferson and Jennings Counties, Indiana. The damsite is about 1 mile north of the town of Deputy, Indiana, and approximately 0.8 mile downstream from the junction of Graham Creek and Big Creek. The project would control 294 square miles or 26 percent of the total 1,140 square mile drainage of the Muscatatuck River. Deputy Reservoir would provide storage for flood control, water quality control, and general recreation and fish and wildlife recreation and enhancement.

Parker Reservoir would be located on West Fork White River in Delaware and Randolph Counties, Indiana. The damsite is about 1 mile west of the Delaware-Randolph County line and 2.5 miles southwest of Parker City, Indiana. The project would control 175 square miles or about 3.3 percent of the total 5,330 square mile drainage basin of West Fork White River. As presently planned, Parker Reservoir would provide storage for flood control, water supply, water quality control, and recreational purposes.

Fall Creek Reservoir would be located on Fall Creek a tributary of the West Fork White River; for this project several alternatives have been considered. It was concluded that a detailed, full survey scope study would be required before final selection of a specific reservoir site could be made. Of the sites considered, the Highland site has received the most support from local interests. The Highland Reservoir would be located in Marion, Hamilton, and Madison Counties, Indiana. The dam would be located in the vicinity of East 79th Street and about 1 mile downstream from the existing Geist Dam and 2 miles north of Fort Benjamin Harrison. The project would control 216 square miles or 68 percent of the total 318 square mile drainage area of Fall Creek. Such a project would provide multipurpose storage to include flood control, water supply, and environmental purposes.

Crawfordsville Reservoir would be located on Sugar Creek, a tributary of the Wabash River in Montgomery County, Indiana. The selected damsite is located about 44 miles above the mouth of Sugar Creek and 3 miles northeast of Crawfordsville, Indiana. At this site, the project would control 423 square miles of the total 840 square miles Sugar Creek drainage basin. As presently planned, Crawfordsville Reservoir would provide storage for flood control, water supply, water quality, and environmental purposes.

Salt Fork Reservoir would be located on Salt Fork, a tributary of the Vermilion River at approximately river mile 1.5. The reservoir would lie mostly in Vermilion County but would reach into Champaign County during flood operations. The project would control 515 of the 517 square mile Salt Fork drainage area. Salt Fork Reservoir, as presently planned, would provide storage for flood control, water quality control, and environmental purposes.

Upstream Watershed Projects

The recommended early action program for inclusion with the present plan in the comprehensive program includes an additional 86 small watershed projects with a total drainage area of 9,654 square miles, 29 percent of the basin. The locations of the proposed projects are shown in figure 98 and data on project measures are shown in table 67. These early action projects include 287 reservoir sites controlling a drainage area of 2,846 square miles; the amount of storage for flood prevention in other purposes total 1.1 million acre feet.

Added water storage for recreation and fish and wildlife is included in 75 reservoir sites of the early action segment, and these reservoirs will provide 24,496 acres of total water surface area. It is estimated that 69 recreation developments in the early action segment will have a total capacity for 6 million visitor days. To meet identified needs for municipal and industrial water supply, 19 structures in the early action segment will store 34,520 acre feet of water. This storage combined with storage in 3 authorized structures will provide a total of 45,592 acre feet of water supply, or about

25,000,000 gallons per day. Water quality storage is included in 22 reservoir sites in the early action segment, and these reservoirs would provide 64,086 acre feet of quality control storage. The release of this storage combined with 2 authorized sites would provide low flow augmentation at 24 locations in the basin. Channel improvements and some levees are needed to provide suitable levels of protection for agricultural production in 65 of the early action small watershed projects. Detailed data on the watershed measures and the specific interrelationship of land treatment measures are contained in Attachment A and Appendix H – Agriculture.

Waste Treatment Facilities

The construction of waste treatment plants and associated collection facilities at many sewage service areas is needed to meet existing Federal Water Quality Standards, as they have been established. Since the states are requiring all sewage service areas to install adequate treatment where needed, the comprehensive plan is limited to those places where conditions indicate the need for new or expanded advanced waste treatment plants to meet water quality standards. Recommendations for new advanced waste treatment for 66 sewage service areas and expanded advanced waste treatment for 40 sewage service areas are listed below. The total estimated cost for these projects is 200 million dollars. In addition, the comprehensive plan recognizes the need for new and expanded primary and secondary treatment facilities. Most communities are under state orders to provide this treatment within the next few years. Collection facilities that are an integral part of any sewage system will, of course, be needed along with treatment facilities. While these are not part of the recommended plan, they were considered in the studies because of the contribution they will make to the total plan. Table 68 lists those advanced waste treatment facilities to meet State requirements for both the early action and long range plans. Those places with adequate existing plants, or plants under construction or in advanced planning are not counted. The details concerning these plants are listed in Appendix F – Water Use and Stream Quality. The estimated cost for the early action treatment facilities as indicated above is $200,000,000, while the collection systems cost is $200,000,000, these latter costs are not part of the comprehensive plan costs.

Coal Mine Drainage Pollution Abatement

Two abatement projects shown on figure 100 are recommended in the early action program. The Coordinating Committee does not now have the detailed information necessary to specify how the abatement is to be accomplished on each of the watersheds. Estimated costs of abatement are based on a combination of preventive measures which appear to have been the most successful treatment processes to date. The estimated cost of abatement based on the foregoing is $10,000,000.

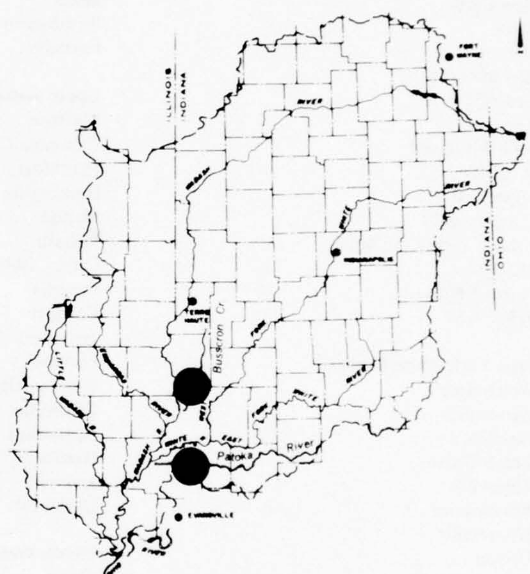


FIGURE 100

COAL MINE ABATEMENT MEASURES

Low Flow Augmentation

Storage for low flow augmentation to enhance water quality is included in five of the six early action major reservoirs and 22 of the upstream reservoirs.

Water Supplies

The features for municipal, industrial, and rural water supplies include the development or improvement of water supplies, treatment facilities, and distribution systems. Water made available by the features of the plan, the supply portion only,

TABLE 68

COMMUNITIES WITH ADVANCED WASTE TREATMENT NEEDS

EARLY ACTION

Patoka Subbasin
Jasper
Huntingburg
Princeton

East Fork White Subbasin
Austin
Franklin
Greensburg
New Castle
Paoli
Vernon
Bloomington
Greenfield
Loogootee
New Whiteland
Rushville
Whiteland
Cumberland
French Lick-West Baden
Mitchell
North Vernon
Scottsville

West Fork White Subbasin
Winchester
Alexandria
Pendleton
Beech Grove
Zionsville
Brownsburg
Mooresville
Linton
Petersburg
Sheridan
Muncie
Elwood
Indianapolis
Lawrence
Greenwood
Plainfield
Greencastle

West Fork White Subbasin (Continued)
Bicknell
Bloomington
Anderson
Tipton
Carmel
Speedway
Homecroft
Danville
Brazil
Washington
Fortville

Upper Wabash Subbasin
Bluffton
Columbia City
Frankfort
Huntington
Marion
Wabash
Celina, Ohio
Dunkirk
Gas City
Jonesboro
Portland
Warsaw-Winona Lake
Coldwater, Ohio
Fairmount
Hartford City
Kokomo
Union City

Middle Wabash Subbasin
Chrisman, Illinois
Georgetown, Illinois
Lebanon, Indiana
Paris, Illinois
Rantoul-Chanute AFB, Illinois
Robinson, Illinois
Sullivan, Indiana
Danville, Illinois
Crawfordsville, Indiana

Middle Wabash Subbasin (Continued)
Hoopeston, Illinois
Marshall, Illinois
Paxton, Illinois
Ridge Farm, Illinois
Rockville, Indiana
Urbana-Champaign, Illinois
Tilton, Illinois
Westville-Belgium, Illinois

Embarras Subbasin
Tuscola
Charleston
Newton
Mattoon
Tolono
Villa Grove
Greenup
Toledo
Oblong
Martinsville
Flat Rock
Sumner
Casey
Arcola

Little Wabash Subbasin
Flora
Olney
Clay City
Altamont
Crossville
Albion
Fairfield
Louisville
Teutopolis
Wayne City
Effingham
Carmi
Neoga
Noble
Enfield

LONG RANGE

Patoka Subbasin
Owensville (Lower Wabash)
Ferdinand
Oakland City

East Fork White Subbasin
Campbellsburg
Glenwood
Shelbyville
Columbus
Hope
Shirley
Crothersville

East Fork White Subbasin (Continued)
Nashville
Spiceland

West Fork White Subbasin
Farmland
Summitville
Cicero
Morgantown
Odon
Parker City
Atlanta
Westfield

West Fork White Subbasin (Continued)
Ellettsville
Elnora
Gaston
Arcadia
Bargersville
Jasonville

Upper Wabash Subbasin
Bourbon
Culver
Lafayette
Ossian

TABLE 68

COMMUNITIES WITH ADVANCED WASTE TREATMENT NEEDS (CONTINUED)

Upper Wabash Subbasin (Continued)	Upper Wabash Subbasin (Continued)	Middle Wabash Subbasin (Continued)
Redkey	Churubusco	Rossville, Ill
St. Henry, O	Kewanna	Terre Haute, Ind
Swayzee	North Webster	Colfox, Ind
Walton	Pierceton	Fowler, Ind
Brookston	Russiaville	Oxford, Ind
Greentown	Somerset	Seelvville, Ind
Montpelier	Van Buren	
Peru	LaFontaine	Dana, Ind
Royal Center	**Middle Wabash Subbasin**	Kirkland, Ind
Silver Lake	Boswell, Ind	Roachdale, Ind
Upland	Farmersburg, Ind	Shelburn, Ind
Wolcott	Otterbein, Ind	West Labanon, Ind

would supply municipal, industrial, and rural water needs of about 658 million gallons per day by the year 1980. Areas with the most urgent development needs are identified on the basin and subbasin maps in parts I and III of this section. All communities having water supply development needs are included in table 69. Municipal water systems include 381 communities, both ground and surface sources would be developed to meet the identified needs. Water supply is a plan purpose in 5 of the major reservoir projects and could be developed at others. Included in this system development would be treatment facilities, disinfecting equipment, elevated storages, and expansion of the distribution systems. The rural water supply features of the plan would provide about 174 million gallons of water per day by the year 1980.

Local Protection Projects

The early action sector includes 11 levee projects for local flood protection and 1 major channel improvement project for flood control and agricultural water management. These Corps of Engineers projects would be located in the Patoka, East Fork White and Lower Wabash Subbasins; the channel improvement project would be located in the Patoka Subbasin. These measures would reduce average annual flood damages by approximately $3,000,000 and reduce the danger of loss of life from flooding. They would cost $50,000,000.

The local protection projects, recommended, are referenced in Appendix L – Project Engineering and illustrated in figure 98 of this report. These measures were found necessary to complement other flood control features in the comprehensive plan. Similar elements of a local protection nature, specifically these incorporated in the upstream watersheds, are not described here but are later tabulated in Attachment 1 of this report.

Patoka Levee Unit 2 is located in Gibson County, between river mile 24.5 and 28.0 on the right bank of the Patoka River. The recommended levee would provide protection for a total of 2,520 acres of land of which 1,900 acres is cultivated. Average height of the levee would be eight feet; the length is 3.31 miles with a 12 foot top width and 1 on 3 side slopes.

Patoka Levee Unit 3 is located in Gibson County between river mile 25.5 and 30.0 on the left bank of the Patoka River. The recommended levee would be 6.63 miles in length with a 12 foot top width and 1 on 3 side slopes. Protection would be provided for 1,930 acres of cultivated land with primary crops of corn and soybeans.

Patoka Levee Unit 4 is located in Gibson and Pike Counties at river mile 29.0 on the right bank of the Patoka River. The recommended levee would provide protection for 1,230 acres, of which 935 are cultivated; principle crops are corn and soybeans. Located on the right bank, the levee would be 3.98 miles in length and have a top width of 12 feet with 1 on 3 side slopes.

TABLE 69

COMMUNITIES WITH EARLY ACTION WATER SUPPLY NEEDS

Patoka Subbasin
Jasper
Huntingburg
Ferdinand
Pike County
Princeton
Rest of Gibson County

East Fork White Subbasin
New Castle
Greenfield
Scottsburg
Austin
Other - Brown County
Other - Lawrence County
Whiteland-New Whiteland
Columbus
Other - Decatur County
Other - Monroe County
Loogootee
Shoals
Other - Martin County
Paoli
West Baden-French Lick

West Fork White Subbasin
Winchester
Mt. Summit
Middletown

West Fork White Subbasin (Continued)
Muncie
Alexandria
Elwood
Rest of Tipton County
Indianapolis
Industries in Monroe County
Putnamville State Farm
Odon

Upper Wabash Subbasin
Portland
Dunkirk
Saratoga
Hartford City
Fowlerton
Gas City
Point Isabel
Rest of Grant County
Lagro
Warsaw
Greentown
Kokomo

Middle Wabash Subbasin
Rural Warren County Industry
Rest of Warren County
Attica
Crawfordsville

Middle Wabash Subbasin (Continued)
Vincennes
Hoopeston
Danville
Georgetown
Paris
Robinson
Rest of Lawrence County
Rest of Wabash County
Terre Haute Area

Embarras Subbasin
Tuscola
Arcola
Charleston
Lawrenceville

Little Wabash Subbasin
Altamont
Edgewood (Mason)
Dieterich
Flora
Louisville
Clay City
Cisne

Lower Wabash Subbasin
Rest of Wabash County
West Salem, Illinois

Patoka Levee Unit 5 is located in Gibson County between river miles 32.0 and 33.5 on the left bank of the Patoka River. The proposed levee would provide protection for 696 acres of which 396 acres are cultivated in corn and soybeans. The levee would be 2.69 miles long and would have an average height of eight feet, a top width of 12 feet and 1 on 3 side slopes.

Patoka Channel Improvement, on a selective basis considering the natural growth of the stream bank, is needed in the interest of flood control from the Highway 507 bridge at river mile 35.5 to Winslow, Indiana. A channel capacity approximating a five year frequency for the foregoing length is the considered plan.

West Levee, Columbus, Indiana is located on the right bank of East Fork of the White River between river miles 239 and 244 near the confluence of Driftwood and the East Fork White Rivers. This unit would protect 2,500 acres of land which presently includes a mixture of commercial and agricultural land use. The levee would require the construction of 6.8 miles of earth levee with an average height of 12 feet.

Wiemeyer Levee is located on the right bank of Clifty Creek about 3.9 miles above the mouth. Construction of this levee unit would require 1.2 miles of earth levee with an average height of seven feet.

Beatty Levee is located in Bartholomew County, Indiana on the left bank of East Fork White River between river mile 239.2 and 243.0. The recommended unit would provide urban protection to about 1,100 acres of land.

Levee Unit 5 is located in Barthlomew County, Indiana , on the left bank of the East Fork of the White River. The unit extends from river mile 235.8 to 239.0 and ties to high ground on the left bank of Clifty Creek about one mile from the mouth.

Levee Unit 17 is located on the left bank of the East Fork White River between mile 214.1 and 219.0 above the mouth of the White River. The proposed levee would provide agricultural protection to a total of 1,450 acres; essentially all of this acreage is intensively farmed. About 4.3 miles of earthen levee with an average height of 6.3 feet would be involved.

Wabash Levee Unit 50 is located on the left bank of the Wabash River in Posey County immediately upstream from New Harmony, Indiana. It extends along the Wabash from mile 52 upstream about one mile to a cutoff, then along the old channel and continuing along the east side of Black River to high ground about two miles southeast of Griffin, Indiana. Protection would be furnished for 3,060 acres of cropland.

EARLY ACTION – ENVIRONMENTAL, REGIONAL AND SOCIAL – MANAGEMENT AND OTHER MEASURES

Environmental Corridors

Within the Wabash River basin are important environmental resources that are closely associated with the river and its tributaries. These resources include the natural or near natural surroundings, exceptional natural areas and historic and archaeological sites which have been particularly vulnerable to the works of man through the urgency of development. Although the reduction in the natural stream-oriented environment caused by any single development or use may not cause a significant change in the total, these influences of man in their cumulative aspect do pose a serious threat to the retainment of sufficient natural surroundings and other related aspects of the environment.

These resources, if perpetuated in an unimpaired or managed state, will go far in providing the people of the basin with substantial recreation opportunity and natural landscapes. The extent to which acquisition or easements are employed for the purposes of establishing controlled land use pattern on stream corridor lands would necessarily take various forms depending upon the specific reach and character of the stream involved. Those lands that are designated for stream access, recreation development, or are of significant, nonrenewing, irreplaceable quality should be purchased in fee. The remainder of land or those segments that lie between modes of fee acquisition could be controlled through combinations of easement and flood plain management in order to accomplish the desired results. The location of the planned environmental stream corridors are summarized in table 70 and illustrated in figure 99.

It is for note that as illustrated, the corridors appear to conflict with several of the reservoir and watershed projects; in these instances more land acquisition commensurate with the corridor objective would be secured.

TABLE 70

ENVIRONMENTAL CORRIDORS

Economic Subarea	Subbasin Location	Stream Mileage
1	Patoka, East Fork, Lower Wabash	406
2	West Fork	261
3	Little Wabash, Lower Wabash	109
4	Embarras	186
5	Middle Wabash	251
6	Upper Wabash	460
TOTAL		1,673

Stream Fishery

Stream fishing access sites can be an important source of fishing opportunity. Preservation would be accomplished by acquisition of minimum acreage of adjacent lands in fee or scenic easements. Access would involve a boat or canoe access facility every five miles. Facilities would depend on the type of land use planned –– primitive and natural areas demanding less access than high intensity areas. Where environmental corridors are involved, additional easements or purchases would be made. Table 71 summarizes stream fishery access locations; they would be located along the designated fishery streams as illustrated in figure 99.

Use of Surface Mined Lands for Recreation

Integral with the rising demand for available lands in the Wabash River basin is the potential inherent in water coupled surface mined areas for water oriented recreation use. It is recommended that mined lands, both coal and sand and gravel, be developed for their maximum re-use recreation capability, particularly for those sites where water development recreation activities can be satisfied.

TABLE 71

STREAM FISHERY

Economic Subarea	Subbasin Location	Access Sites
1	Patoka, East Fork, Lower Wabash	266
2	West Fork	418
3	Little Wabash, Lower Wabash	126
4	Embarras	278
5	Middle Wabash	182
6	Upper Wabash	304
TOTAL		1,604

Lakes created as a result of surface mining for coal in the Wabash River basin ranges from as little as one acre to over 200 acres and averages out to about one acre of surface water to ten acres disturbed. At the projected rate of surface mining, about 27,100 acres of water is expected to be created between the years 1960 and 2020, see table 72.

Preplanning will be vital to the successful utilization of these lands for recreation and community acceptance to provide proper access, to establish desirable vegetation and to provide aesthetically pleasing and functional landscapes.

Major Reservoirs

As discussed under major reservoirs, the 6 multipurpose reservoirs in the early action segment would provide facilities for both recreation and fish and wildlife purposes. A surface area of 200,000 acres would be provided by the conservation pools when they are full. The construction of these impoundments would greatly increase the fishery habitat base in the basin area, and increased fishery opportunities could be provided. Similarly, wildlife management practices could be applied and certain project lands open to the public. This latter opportunity is particularly important with the

TABLE 72

SURFACE MINED LANDS 1/ AND
ESTIMATED WATER AREA DEVELOPABLE FOR RECREATION USE

Economic Subarea	1	2	3	4	5	6	Totals
EARLY ACTION							
Existing Surface-mined Lands (Acres)	26,292	26,626	344	4,836	20,045	—	78,143
Existing Water Surface on Mined Lands (Acres)	4,718	3,451	20	425	2,431	—	11,045
Estimated Areas (Acres), to be Surface Mined by 1980	6,800	36,700	—	—	8,610	3,100	55,210
Estimated Water Surface Acres to be Added from Surface Mined Areas by 1980	680 2/	4,600 4/	—	1,022 6/	1,081 7/	790	8,173
LONG RANGE							
Estimated Areas (Acres), to be Surface Mined 1980–2020	58,800	80,480	—	30,000	34,400	12,640	224,360
Estimated Water Surface (Acres) to be Added from Surface Mined Areas, 1980–2020	6,025 3/	13,470 5/	—	3,000	5,150 8/	3,160	30,805

1/ Includes coal and sand gravel operations.
2/ Includes 180 acres of water from sand gravel mining.
3/ Includes 145 acres of water from sand gravel mining.
4/ Includes 1,700 acres of water from sand gravel mining.
5/ Includes 7,700 acres of water from sand gravel mining.
6/ Includes 322 acres of water from sand gravel mining.
7/ Includes 220 acres of water from sand gravel mining.
8/ Includes 1,710 acres of water from sand gravel mining.

constantly decreasing wildlife habitat base which makes it increasingly difficult to provide sufficient hunting opportunities.

Upstream Watersheds

As mentioned previously, the upstream watersheds included in the early action segment would provide 24,496 acres of water surface for recreation and fish and wildlife purposes. Generally speaking, added water storage recreation and fish and wildlife is included in 75 early action, 12 authorized project reservoir sites, and these reservoirs would provide the 24,496 acres and 3,577 acres, respectively, for a total water surface area of 28,073 acres. It has been estimated that 69 recreation developments in the early action small watershed projects and 12 recreation developments as authorized will have capacity for over 6 million visitor days.

Stream Access

Stream access sites are proposed for the streams having environmental corridors and stream fishery preservation measures. More than 175 sites are included in the early action segment. Some sites would be developed for intensive use, but most would provide for only limited use in order to preserve natural environmental quality conditions.

Cleaning Its Waters

Many of the measures to significantly clean up the river are proposed in the National Income Efficiency plan, but there is still the problem of junk and debris in our river and its tributaries which is a fact that is likely to continue in our growing economy. A cleaner river in itself will deter a good many people from cluttering it, but public education, appropriate fines and better pickup service must be encouraged at all levels of government.

Land Treatment

The early action recommendations for land treatment are composed of three principal elements. Accelerated land treatment is the first of these, and

FIGURE 101. EARTH RIDGE DIVERSIONS ARE ONE FORM OF LAND TREATMENT THAT PROTECTS AGAINST EROSION AND WETNESS BY REMOVING EXCESS SURFACE WATER

it is proposed for watershed protection under PL 566 in the upstream watershed projects. A second is an acceleration of land treatment in the drainage areas above major reservoirs in the basin. The third would be the accomplishments expected under the going PL 46 program, the cooperative State-Federal forestry program and other going programs in all areas of the basin. Treatment of 8.5 million acres, including 6.5 million acres of cropland, 900 thousand acres of pasture, 680 thousand acres of forest, 208 thousand acres of other land and 216 thousand acres of urban land would be treated in the early action plan. Table 73 presents the early action recommendations by economic subarea. Included in the program are land and water conservation measures for erosion control, water supply, forest treatment, drainage, soil surveys, and fish and wildlife, along with other measures expected to be accomplished mainly by and on properties of individual land users.

TABLE 73

EARLY ACTION LAND TREATMENT

Economic Subarea	Cropland	Pasture	Forest	Urban	Other	Total
			(1,000 Acres)			
1	895	240	277	56	54	1,522
2	1,350	201	160	84	60	1,855
3	594	96	61	6	14	771
4	1,105	106	54	15	23	1,303
5	572	76	60	6	12	726
6	1,940	182	68	49	45	2,284
Total	6,456	901	680	216	208	8,461

Flood Plain Regulation

As is indicated in Appendix B – Economic Base Study, the basin cities are expanding; new buildings are being built; industries are constructing new plants; and most of this is being accomplished on lands that have been previously undeveloped until now. This growth is most necessary and healthy so long as it respects the land on which it is built. Physical protection against floods, such as dams and floodwalls, cannot answer the complete problem as the rate of development in the flood plain exceeds any possible plan for complete physical protection. Flood plain management measures are listed in table 74.

Reservoir Regulation Study

A basin wide regulation study is needed to determine an optimum regulation pattern for the basin reservoirs with special consideration to the aquatic environment of both the main stem and tributary streams. Such a study would involve both low flow and flood conditions for representative periods. Operation procedures would be developed with a balanced view of the project objectives and the Basin's environment. Flood holdouts and low flow releases would be evaluated for various time increments for the development period of the comprehensive plan to 2020.

Land Use Study

A comprehensive land use study is recommended which would accurately establish existing land use patterns, and the physiography and cultural features for each county within the basin; formulate statewide land use development objectives and standards; and design future land use patterns to best meet these objectives. It is proposed that such a plan would give detailed consideration to the environmental corridor and stream fishery systems commensurate with public visitation, wildlife habitat and preservation needs and features identified in the environmental inventory. It is further proposed that such a plan be used to identify where encroachments or threats to environmental quality exist and to identify the type, amount and spatial location of land uses required of the Basin's flood plains. The states by using such a land use plan as a frame of reference, could formulate land use regulation and development to preserve or conserve the natural and cultural environment. They could formulate flood plain use regulation development policies and, with the aid of supporting data, determine the area in which flood hazards exist and indicate the most appropriate uses of such areas in the best interest of the people.

Grand Lake Study

Less than one percent of the Wabash Basin is located in Ohio, however, in this area Grand Lake is located. The lake is situated on the divide between Lake Erie and Ohio River drainage. About 13,500 acres of surface area are involved. Considerable eutrophication has occurred and many other local problems concerning the lake and adjacent lands have accumulated over the years. The Flood Control Act of 1970 authorized a study for Grand Lake for the purposes of considering its reconstitution and related problems.

Study for Regional Centers and Power Development Areas

As pointed out previously in this report, the population of the basin is projected to about double during the study period to 2020. With this knowledge of projected growth and the related projection data developed during the course of the comprehensive study – that part of the planning process known as trend identification – we have managed to peer into

the need for new regional centers. Such centers and power development areas are the only ways such forseen increases in population can be accommodated systematically in the present day. Prerequisite to this is planning with the objective of harmonious utilization of the resource base; cost items for resource planning fundamental to the three potential regional centers and power development areas is included as a part of the comprehensive plan.

LONG RANGE STRUCTURAL MEASURES

Major Reservoirs

The Coordinating Committee has identified seven major reservoirs which can be utilized to alleviate an array of 2020 water resource needs. Those are described in the following paragraphs and illustrated in figure 98.

TABLE 74

COMMUNITIES IDENTIFIED FOR POTENTIAL FLOOD PLAIN MANAGEMENT SERVICES BY SUBBASIN

Patoka Subbasin
Dubois
Huntingburg
Jasper
Patoka
Winslow

East Fork Subbasin
Austin
Bedford
Bethel Village
Bloomington
Columbus
Edinburg
Franklin
French Lick
Greenfield
Greensburg
Greenwood (Johnson County)
Knightstown
New Castle
New Whiteland
North Vernon
Orleans
Paoli
Rushville
Scottsburg
Seymour
Shelbyville
Shoals
West Baden

West Fork Subbasin
Alexandria
Anderson
Anderson, East Side
Bicknell
Brooklyn
Brownsburg
Chesterfield
Danville
Elwood
Greenwood
Linton

West Fork Subbasin (Continued)
Indianapolis
  Beech Grove
  Lawrence
  Speedway
Martinsville
Mooresville
Muncie
Noblesville
Petersburg
Plainfield
Spencer
Tipton
Washington
Winchester

Upper Wabash Subbasin
Bluffton
Delphi
Edna Mills
Fairmount
Gas City
Hartford City
Home Corner
Huntington
Kokomo
Lafayette
Logansport
Marion
Monitor
North Manchester
Peru
Portland
Union City
Wabash
Warsaw
West Lafayette

Middle Wabash Subbasin
Attica
Clinton
Covington
Crawfordsville
Danville, Illinois

Middle Wabash Subbasin (Continued)
Eugene
Hutsonville, Illinois
Lebanon
Montezuma
Newport
Paris, Illinois
Paxton, Illinois
Rantoul, Illinois
St. Joseph, Illinois
Terre Haute
Urbana, Illinois
Vincennes
West Terre Haute
York, Illinois

Embarras Subbasin
Birds
Camargo
Charleston, Illinois
Lawrenceville, Illinois
Mattoon, Illinois
Newman
Newton, Illinois
Tuscola, Illinois
Villa Grove

Little Wabash Subbasin
Carmi, Illinois
Clay City
Concord (Emma)
Crossville
Effingham
Fairfield
Golden Gate
Louisville
Mill Shoals
New Haven
Springerton

Lower Wabash Subbasin
Grayville, Illinois
Mount Carmel, Illinois
New Harmony

Maltersville Reservoir would be located on Straight Creek, a tributary of Patoka River in Dubois County, Indiana. The damsite is about three miles above the confluence with Patoka River and approximately four miles southeast of Jasper, Indiana. Stream control of 62 square miles would be established on 90 percent of the 67 square mile drainage area.

Upper Martinsville Reservoir would be located on West Fork White River in Morgan, Johnson and Marion Counties, Indiana. The damsite is about two miles southwest of the town of Centerton, Indiana. Stream control would be established on 2,110 square miles or approximately 40 percent of the total 5,330 square mile drainage area of West Fork White River.

Deer Creek Reservoir would be located on Deer Creek, a tributary of Wabash River, in Carroll County, Indiana. The damsite is about four miles upstream from the confluence of Deer Creek and Wabash River and two miles east of Delphi, Indiana. Deer Creek project would control 280 square miles or 95 percent of the total 295 square mile Deer Creek drainage basin.

Denver Reservoir would be located on Eel River, a tributary of the Wabash River, in Miami and Wabash Counties, Indiana. The damsite is one mile east of Denver, Indiana and about 1.5 miles west of Chili, Indiana. Stream control would be established for 680 square miles or 79 percent of the total 860 square mile drainage area of Eel River.

Pipe Creek Reservoir would be located on Pipe Creek a tributary of the Wabash River, in Miami County, Indiana, with the extreme upper portion of the reservoir extending into Wabash County. The damsite is about 6.5 miles upstream from the mouth of Pipe Creek and approximately five miles southwest of Peru, Indiana. Stream control would be established for 167 square miles or about 87 percent of the total 193 square mile drainage area of Pipe Creek.

Delphi Upper Reservoir would be located on the main stem of the Wabash River at about river mile 333 in Carroll and Cass Counties, Indiana. The damsite is 1.5 miles northeast of Delphi, Indiana, and would control 4,136 square miles of the total 33,100 square mile drainage basin of the Wabash River.

Coal Creek Reservoir would be located in the southwest corner of Fountain County, Indiana. The damsite is located about four miles above the mouth of Coal Creek and approximately one mile north of the Fountain-Parke County line. Stream control would be established for 256 square miles or 97 percent of the total 264 square mile drainage basin of Coal Creek.

Upstream Watershed Projects

Opportunities for small watershed development exist in 61 areas in addition to those identified for the early action program. These potential projects have a combined drainage area of 3,510 square miles and include 97 reservoir sites controlling a drainage area of 805 square miles. The sites would provide 368 thousand acre feet of storage for sediment, flood prevention and other uses. They could provide 13,990 acres of water surface and satisfy a demand of 2.3 million annual visitor days in 26 additional recreational developments. Project areas are illustrated in figure 98 and detailed data presented in Attachment A.

Waste Treatment

Under the pressures of future population and industrial growth, abatement of pollution and the control of its effects will receive continuing attention. The construction of 40 new or expanded advanced waste treatment plants will be required to meet the State water quality standards with the projected waste loads; areas of need are summarized in table 68.

As the total program of planned treatment takes effect, specific new problems will emerge in the light of future growth patterns and technology changes. New water quality advances will take place, and the process is likely to be a continuing process of re-evaluation.

Water Supply

Future demands for water supply will likely necessitate the development of water resources not specifically foreseen in the long range plan. However, most of the major reservoir sites and those of the upstream watershed sites have additional capability if such storage is necessary. The future needs of the communities identified in table 75 are met by the long range plan.

TABLE 75

COMMUNITIES WITH LONG RANGE WATER SUPPLY NEEDS

Patoka Subbasin
Jasper
Huntingburg
Ferdinand
Pike County
Oakland City
Princeton
Rest of Gibson Co.

East Fork White Subbasin

New Castle
Carthage
Rushville
Morristown
Shelbyville
Greenfield
Edinburg
Whiteland - New Whiteland
Franklin
Other - Johnson Co.
Columbus
Hope
Greensburg
Other - Decatur Co.
Medora
Crothersville
Scottsburg
Austin
Vernon - North Vernon
Nashville
Other - Brown Co.
Other - Lawrence Co.
Bloomington
Other - Monroe Co.
Loogootee
Shoals
Other - Martin Co.
Washington Co.
Orleans
Paoli
West Baden - French Lick

West Fork White Subbasin
Winchester
Rest of Randolph Co.
Mt. Summit
Middletown
Muncie
Fortville
Chesterfield
Anderson
Alexandria
Summitville
Orestes
Frankton
Elwood

West Fork White Subbasin (Continued)
Lapel
Tipton
Rest of Tipton Co.
Noblesville
Cicero
Westfield
Rest of Hamilton Co.
Indianapolis
Rest of Boone Co.
Brownsburg
Pittsboro
Plainfield
Danville
Mooresville
Martinsville
Rest of Morgan Co.
Industries in Monroe Co.
Greencastle
Putnamville State Farm
Rest of Putnam Co.
Brazil
Rest of Clay Co.
Jasonville (Hymeria)
Linton (Dugger)
Odon
Washington
Rest of Daviess Co.
Bicknell
Rest of Gibson Co.

Upper Wabash Subbasin
St. Henry, O.
Coldwater, O.
Roanoke
Huntington
Andrews
Bluffton
Portland
Dunkirk
Union City
Saratoga
Rest of Randolph Co.
Albany
Eaton
Hartford City
Upland
Fowlerton
Gas City
Jonesboro
Marion
Swayzee
Point Isabel
Rest of Grant Co.
Largo
Wabash
North Manchester
Warsaw

Upper Wabash Subbasin (Continued)
Mentone
Churubusco
Columbia City
South Whitley
Rest of Marshall Co.
Peru
Converse
Akron
Rochester
Rest of Fulton Co.
Winamac
Galveston
Greentown
Kokomo
Tipton Co.
Frankfort
Rest of Clinton Co.
Flora
Delphi
Monticello
Monon
Rest of White Co.
Lafayette Area

Middle Wabash Subbasin
Lebanon
Rest of Boone Co.
Fowler
Rural Warren Co. Industry
Rest of Warren Co.
Veedersburg
Covington
Attica
Rest of Fountain Co.
Crawfordsville
Rest of Putnam Co.
Rockville
Rest of Parke Co.
Rural Vermillion Co. Industry
Terre Haute Area
Sullivan
Rest of Sullivan Area
Vincennes
Rest of Knox Co
Paxton
Hoopeston
Rossville
Danville
Georgetown
Rantoul
Champaign
Rest of Champaign Co.
Paris
Marshall
Robinson
Rest of Lawrence Co.
Rest of Wabash Co.

TABLE 75

COMMUNITIES WITH LONG RANGE WATER SUPPLY NEEDS (CONTINUED)

Embarras Subbasin	Embarras Subbasin (Continued)	Little Wabash Subbasin (Continued)
Champaign County	Rest of Jasper County	Olney
Tuscola	Lawrenceville	Fairfield
Arcola		Cisne
Villa Grove	**Little Wabash Subbasin**	Enfield
Rest of Douglas County	Mattoon	
Charleston	Altamont	**Lower Wabash Subbasin**
Rest of Coles County	Edgewood (Mason)	Rest of Gibson County, Indiana
Casey	Dieterich	Rest of Wabash County, Illinois
Rest of Clark County	Flora	Rest of Richland County, Illinois
Cumberland County	Louisville	West Salem, Illinois
Newton	Clay City	Grayville, Illinois

LONG RANGE – ENVIRONMENTAL, REGIONAL AND SOCIAL – MANAGEMENT AND OTHER MEASURES

Parkway and Trails

As indicated earlier, there are no regional scenic parkways or trails, as such, in the basin. The Wabash, in its long northeasterly path, from the mouth of the river, suggests a route for a scenic parkway and trail system, see figure 99. As envisioned, a parkway-trail system from Old Shawneetown, Illinois to Lafayette, Indiana combined with the existing and proposed Interstate network would offer frequent views of the river and secure, at least in part, preservation of the river shore in its natural condition.

Scenic road standards depend on control of roadside development through wide rights-of-way, scenic easements, encouragement of compatible land uses, and enhancement of roadside esthetics.

A first step in establishing a Wabash trail system would be securing the right of way for the parkway. The trail itself could be a beginning for future major loop trails up some of the more scenic tributaries and perhaps connected with the trail systems of the Hoosier National Forest and Shawnee National Forest.

Major Reservoirs and Upstream Watersheds

Beyond the basic storage allocation for flood control, the seven major reservoirs and upstream watersheds would have facilities and programs to utilize the recreation and fish and wildlife potentials of the general project areas. Lands for these latter features would involve those directly related to water resources at the site and those that would be indirectly associated with water resource development. A surface area of 200,000 acres would be provided by minimum and conservation pool levels when they are full.

Land Treatment

In addition to the program recommended for the next 10-15 years, land treatment that cannot be reasonably completed during the early action period should be completed after this period. This remaining program, as summarized in table 76, would include treatment of 5.1 million acres at a technical assistance cost of $35.1 million and a program cost of $89.2 million.

TABLE 76

LONG RANGE LAND TREATMENT

Economic Subarea	Cropland	Pasture	Forest	Urban	Other	Total
			(1,000 Acres)			
1	420	120	490	186	26	1,242
2	500	41	259	316	24	1,140
3	216	34	92	36	5	383
4	405	40	93	78	10	626
5	298	46	115	30	7	496
6	840	68	93	177	23	1,201
Total	2,679	349	1,142	823	95	5,088

Hoosier Lake National Recreation Area

Outdoor recreation is a vital part of the American way of life, and many of the most popular outdoor activities are dependent on water and related land resources. As is generally

demonstrated at the completed reservoir projects in the basin, millions of people enjoy picnicking, sightseeing, fishing and boating activities and hiking in wilderness areas, seeking rest and relaxation.

Because of this growing demand, a large water based recreational complex, situated in the rolling hills of Lawrence, Orange, Washington, and Jackson Counties, Indiana, and incorporating the adjacent National and State Forests, the Spring Mill State Park, Starve Hollow State Beach and other scenic, historical and other natural features within the general areas, is recommended as a long range development. Such a development would serve part of the growing need for large, outdoor recreational areas in the midwestern area of the Nation.

Tentatively named the Hoosier Lake National Recreation Area, the program would draw together the foregoing recreation areas under unified management and development. A two level impoundment on the East Fork White River surrounded by the wooded hills and valley area would comprise the dominent development feature. The lake area is illustrated in figure 99.

The recreation potential inherent in the site near Shoals on the East Fork White River would appear to be of regional and national significance, transcending the Wabash River basin boundaries. The project would have the capability of providing a high quality recreation experience for a very large number of people residing in Indiana and bordering states.

About 26,590,000 people resided within 250 miles of the project in 1960, and about 7,917,000 lived within 150 miles. Two of the nation's largest cities, Chicago and St. Louis and several other large cities including Cincinnati, Columbus, Dayton, Toledo, Indianapolis, South Bend, Gary, Fort Wayne, Louisville and Peoria, are located within 250 miles of the project site.

In addition to the site's considerable recreation value, it occupies what would be the center or core of a multi-county resource oriented complex.

Portions of Martin County State Forest, Spring Mill State Park and Hoosier National Forest are in or immediately adjacent to the impoundment. Crane Naval Ammunition Depot, a 62,800 acre military reservation located just northwestward of the impoundment, would contribute significantly in added recreation benefits if and when these lands become surplus to military needs.

The project would back water in a tributary to the dam of Monroe Reservoir, which with a seasonal pool of about 11,000 acres, is the largest lake in the State of Indiana. At elevation 506 feet mean sea level, the Shoals Reservoir would have a seasonal pool of about 34,000 surface acres. In near proximity of the project is the new Muscatatuck National Wildlife Refuge. The complex would provide a variety of outdoor recreation opportunity to a great number of people, be a major tourist attraction in the midwest and contribute significantly to the economy of south central Indiana.

(Courtesy of the Jasper Herald)

FIGURE 102. JASPER, INDIANA, LARGEST TOWN IN THE PATOKA SUBBASIN – DURING MAY 1961 FLOOD

PART III – SEGMENTS OF COMPREHENSIVE BASIN PLAN

PATOKA SUBBASIN

Southernmost of the Wabash River subbasins, the Patoka Subbasin heads in the rugged topography of the Crawford Upland and extends westward across the Wabash Lowland to the main stem of the Wabash. The Patoka River itself lies south of the East Fork and West Fork White River and flows almost due west throughout its course across southern Indiana. Its mouth is about one mile south of the White River near Mt. Carmel, Illinois. The subbasin is illustrated on the map presented as figure 103. It is long and narrow with a length of about 80 miles and a maximum width of about 20 miles; the subbasin encompasses an area of 862 square miles. Tributaries draining the periphery of the basin are usually steep, but the Patoka itself has a very low gradient especially in the lower reaches. Periods of flooding are common. The area lies in a region where low amounts of ground water are in storage, so sustained low flow is poor. Average summertime temperatures, June through September, are about 74 degrees F.; normal precipitation is about 42 inches.

Principal communities are Huntingburg, Jasper, Oakland City and Princeton, none of which contained more than 8,000 persons in 1960. The total population of the subbasin area is projected to increase 1.9 percent annually from 70,209 in 1960 to 150,200 in 2020. Dubois County is projected to have the highest annual increase in the area of 2.8 percent between 1960 and 2020; Pike County has the lowest projected increase of 0.2 percent. In 1960, 28.7 percent of the labor force was employed in manufacturing, amounting to 7,240 persons and 29.9 percent of the total study area employment of 24,200. Employment is expected to increase from the 24,200 in 1960 to 61,400 in 2020, an increase of 2.6 percent per year.

The plan of development for the Patoka Subbasin includes the authorized, multipurpose Patoka Reservoir and a portion of the completed Levee Unit 5 near the mouth of Patoka River in Gibson County. Also, the authorized Levee Unit 17 is located near the mouth on the north side of the stream in Gibson County. No small watershed projects were authorized or completed in the Patoka Subbasin as of 31 December 1968.

As presented in this report, the comprehensive plan of development for the Patoka recommends three small watershed projects and four agriculture levee units for construction under the early action phase of the comprehensive plan. A total of 280 square miles of project area would be encompassed by the PL 566 projects and a total multipurpose storage capability of 45,000 acre feet would be provided by the structures, which would furnish control for 58 square miles of drainage area.

Levee units, located from river miles 24.5 to 33.5, would provide 15-year frequency-protection for a total of 6,400 acres of agricultural land.

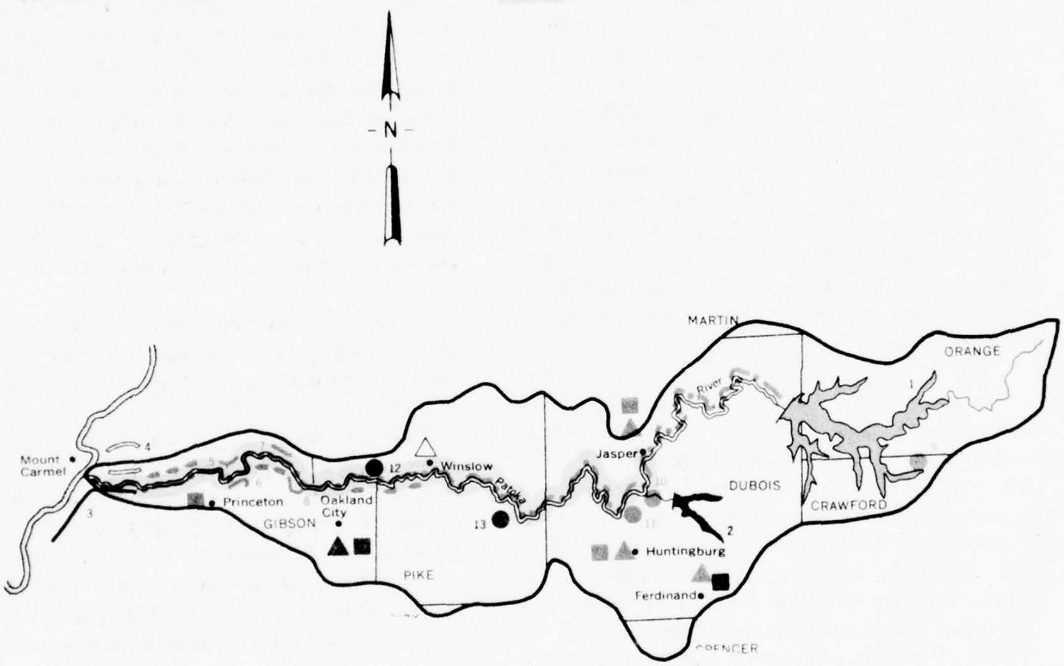
Two additional small watershed projects are recommended for the long range plan. They would contain a total project area of 32 square miles and control 9 square miles of drainage area. Storage would be 4,140 acre-feet. Also in the long range plan is a multipurpose Corps' reservoir on Hall-Flat Creek. This project, the Maltersville Reservoir, would control 62 square miles of drainage basin.

Also included in the more general or basinwide development and preservation measures are the environmental corridors and stream fishery access, illustrated in figure 99; municipal and industrial water supply and water quality measures, land treatment, flood plain management and public health considerations are still other features of the plan which are not illustrated.

PATOKA SUBBASIN PLAN

PROGRAMS	1968 GOING PROGRAM	AUTHORIZED	1980 EARLY ACTION	2020 LONG RANGE
MAJOR RESERVOIR				
WATERSHED PROJECT				
LEVEES				
CHANNEL IMPROVEMENT				
STREAM FISHERY				
ENVIRONMENTAL CORRIDORS				

VICINITY MAP



WATER SUPPLY

PROGRAMS NOT SHOWN

ADVANCED WASTE TREATMENT
MINE POLLUTION ABATEMENT
WATER SUPPLY
RECREATION - SURFACE MINE AREAS
STREAM ACCESS
LAND TREATMENT
FLOOD PLAIN REGULATION
FORESTRY
PUBLIC HEALTH

FIGURE 103

TABLE 77

PATOKA SUBBASIN – PLAN FEATURES AND FINANCIAL DATA

Project or Program	Subbasin Project No 1/	Purpose 2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Totals ($1,000)
EARLY ACTION AND LONG RANGE STRUCTURAL MEASURES						
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
Major Reservoir Projects						
Patoka Reservoir	1	FC,WQ,WS,R			29,324	29,324
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Upstream Watershed Projects						
Hunley-Eli	11	FC,R,WQ,WS	3,689	1,549	5,238	
Upper Patoka	9	FC,WQ,WS	518	153	671	
Hall-Flat Creek	10	FC,R,WQ,WS	2,111	825	2,936	8,845
Local Protection Projects						
Patoka Levee Unit 2	5	FC	470	25	495	
Patoka Levee Unit 3	6	FC	500	57	557	
Patoka Levee Unit 4	7	FC	377	44	421	
Patoka Levee Unit 5	8	FC	225	21	246	
Patoka Channel Improvement	—	FC	4,000	50	4,500	6,219
Advanced Waste Treatment	—	WQ	—	730	730	730
Mine Pollution Abatement	—	WQ	4,000	—	4,000	4,000
Water Supply	—	WS	—	250	250	250
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Major Reservoir Projects						
Maltersville	2	FC,R	7,191	1,969	9,160	9,160
Upstream Watershed Projects						
Flat Creek	12	FC,WS	72	41	114	
Cup Creek	13	FC,R,WS	328	251	579	693
Advanced Waste Treatment	—	WQ	—	2,000	2,000	2,000
Water Supply	—	WS	—	2,000	2,000	2,000
EARLY ACTION AND LONG RANGE ENVIRONMENTAL REGIONAL AND SOCIAL MANAGEMENT AND OTHER MEASURES						
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Environmental Corridors	—	E,R,FW	1,560	1,560	3,120	3,120
Stream Fishery Preservation	—	E,R,FW	205	205	410	410
Access Sites	—	E,R,FW	67	67	134	134

TABLE 77

PATOKA SUBBASIN – PLAN FEATURES AND FINANCIAL DATA (CONTINUED)

Project or Program	Subbasin Project No.1/	Purpose2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Totals ($1,000)
Flood Plain Management	—	FC,E	63	—	63	63
Use of Surface Mined Areas for Recreation	—	E,R,FW	257	257	514	514
Land Treatment	—	E,SC	3,108	3,080	6,188	6,188
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Land Treatment	—	E,SC	1,411	1,398	2,809	2,809
Flood Plain Management	—	FC,E	50	—	50	50
Use of Surface Mined Areas for Recreation	—	E,R,FW	730	730	1,460	1,460
TOTALS 3/ - Federal First Cost			30,932			
Non-Federal First Cost				17,713		
Subbasin Grand Total					48,645	48,645

1/ Numbers refer to figure 103.
2/ Purpose index - see table 66.
3/ Subbasin plan does not include basinwide measures.

TABLE 78

PATOKA SUBBASIN DATA

General	
Area (square miles)	862
States (percent)	
Illinois	0
Indiana	100
Ohio	0
Physiographic areas (percent)	
Wabash Lowlands	50.6
Crawford Upland	27.5
Mitchell Plain	21.9
Total	100.0

Population and Employment	1960	2020
Employment sectors (100)		
Agriculture	35	11
Mining	12	8
Construction	13	51
Manufacturing	72	217
Transportation	14	39
Trade	39	124
Finances	5	17
Services	39	105
Government	7	37
Non-classified	6	5
Population (100)	702	1502
Labor Force (100)	252	648
Employment (100)	242	614

EAST FORK SUBBASIN

This subbasin, lying generally in the southeastern portion of the Wabash River basin and containing 5,746 square miles, is the third largest in the study area; it lies entirely within Indiana. The roughly crescent shaped subbasin extends eastwardly and then northeastwardly from the juncture of Pike, Daviess and Knox Counties to the vicinity of northeastern Henry County, near New Castle, a distance of about 150 miles. Maximum width of the subbasin is about 50 miles. Principal tributaries of the East Fork include Lost River, which drains 376 square miles of unique Karst topography; Salt Creek, Muscatatuck River, Sand Creek, Clifty Creek, Flatrock River, Big Blue River and Sugar Creek, the last two uniting to form Driftwood River at Edinburg in Johnson County. Driftwood and Flatrock Rivers form the East Fork at Columbus, 15 miles downstream. A map of East Fork Subbasin is presented as figure 105.

The physiographic features of the East Fork Subbasin are interestingly varied. The upper stream reaches are in the glaciated Tipton Till Plain; south of this area, the stream enters the Scottsburg Lowlands and then flows westwardly into the rough, hilly, unglaciated Mitchell Plain, bordered on the east by the Norman Uplands and the Crawford Uplands in the west. The stream is deeply entrenched amid the rolling hills and offers considerable scenic beauty as it winds its way through the rugged Southern Indiana knobs. Continuing westward, the stream emerges from the ancient, deeply dissected plateau area and flows onward through the undulating Wabash lowlands to its juncture with the West Fork near Petersburg, Indiana.

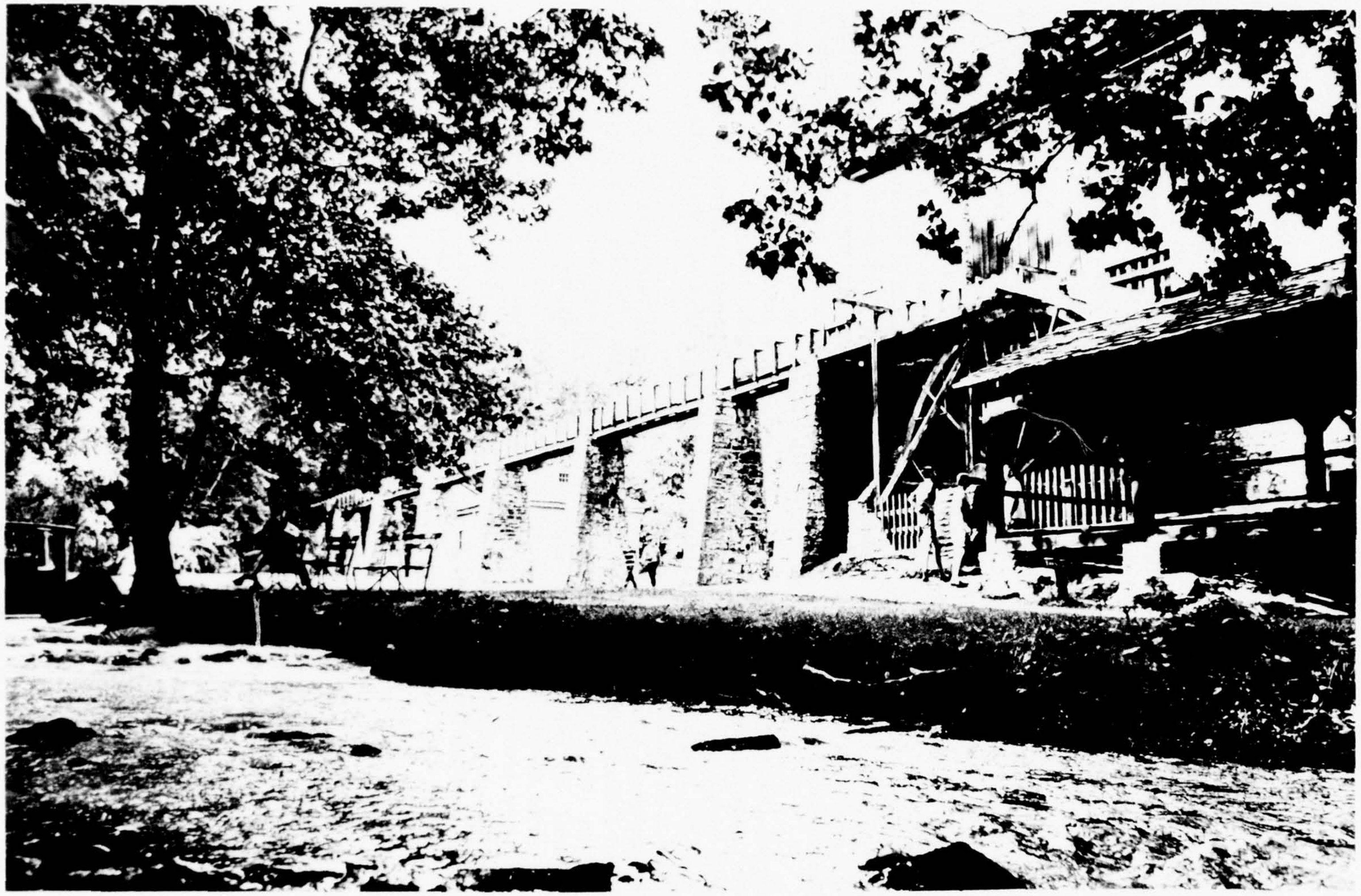
Normal annual precipitation in the East Fork ranges from approximately 39 inches in the extreme upper portion to about 43 inches near the mouth of the stream. Temperature generally ranges from a July mean daily maximum of 87 degrees near New Castle to 90 degrees in the vicinity of Petersburg. Mean daily minimum temperatures in January range from 22 degrees to 26 degrees for these locations.

The largest urban centers in this subbasin are Bloomington (located on the basin divide with the West Fork), Columbus and New Castle, with 1960 populations of 42,890, 27,141 and 21,215, respectively. A population increase of about 2 percent annually is forecast for this subbasin with a growth from a 1960 population of 409,000 to more than 1,000,000 by 2020. Counties that are expected to exhibit the greatest population growth between 1960 and 2020 are Monroe, Martin, and Bartholomew with overall growths of 301 percent, 278 percent and 240 percent for the 60 year period. The labor force is projected to expand to 2.64 times the 1960 total of 156,000 by 2020.

The comprehensive plan for water resources development within the East Fork Subbasin is primarily oriented toward the reduction of extensive and continually increasing flood damages in the rich, productive river bottoms, especially the reach between the mouth of Muscatatuck River and the Columbus area. Total present (1968) damages for this main stem reach amount to about $6,150,000 annually. The general program also provides for improvements in cropping and soil-water conservation practices, drainage, forestry management, pollution abatement, municipal and industrial water supply, improvement in stream fishing and wildlife habitat and outdoor recreation facilities.

The plan of development, as of 31 December 1968, for the East Fork Subbasin includes the completed Monroe Reservoir and the authorized Downeyville, Big Blue and Clifty Creek Reservoirs. There are also two authorized agricultural levees, these being Units 2 and 3, which are located in Jackson County, and authorized local protection projects at Shoals and Orleans. The Shoals project consists of levee protection while a channel improvement project is considered at Orleans. There were, by 31 December 1968, three completed small watershed projects within the East Fork Subbasin and six others were authorized for construction.

The recommended early action program for East Fork Subbasin includes 12 small watershed projects, 5 local protection projects, and 2 large multipurpose Corps of Engineers reservoirs, all of which are scheduled in the water resource investment program for this report through 1985. The early-action Public Law 566 projects provide for land treatment measures on much of the 1,631 square miles of project area. Multipurpose storage in the total amount of 252,770 acre-feet would be impounded behind the structures, which would control a total of 682 square miles. The recommended early action



(Courtesy of the Indiana Department of Natural Resources)

FIGURE 104. SPRING MILL STATE PARK – EAST FORK SUBBASIN

Corps' projects are the Azalia Reservoir on Sand Creek and Deputy Reservoir on the Muscatatuck River. Together, they would control 544 square miles and provide a total of 226,900 acre-feet of storage. Four local protection projects are recommended at Columbus. These are the West Levee, protecting the area west of the river, the Wiemeyer Levee, the Beatty Levee and Levee Unit No. 5. At Seymour, Levee Unit 17 is proposed for protection of agriculture land near the city.

The long range program for this subbasin will concentrate on development of other watershed projects, now estimated to be 9 in number, which can contribute an additional 78 square miles of drainage area controlled by impoundment structures. Total additional storage for sediment, flood control and other uses would amount to 50,500 acre-feet. Total project area for all long-range small watershed projects would be 470 square miles.

Other features in East Fork Plan include the more general or basinwide development and preservation measures for the environmental corridors, stream fishing access, municipal and industrial water supply and water quality measures, land treatment, flood plain management and public health considerations.

TABLE 79

EAST FORK WHITE SUBBASIN DATA

General

Area (square miles)	5746
States (percent)	
Illinois	0
Indiana	100
Ohio	0
Physiographic areas (percent)	
Tipton Till Plain	21.6
Wabash Lowlands	3.9
Crawford Upland	10.6
Mitchell Plain	8.7
Norman Upland	14.0
Scottsburg Lowland	17.3
Muscatatuck Regional Slope	23.9
Total	100.0

Population and Employment

	1960	2020
Employment sectors (100)		
Agriculture	154	44
Mining	8	30
Construction	82	252
Manufacturing	511	1408
Transportation	70	214
Trade	235	620
Finances	34	132
Services	281	861
Government	58	307
Non-classified	39	24
Population (100)	4088	11026
Labor Force (100)	1557	4113
Employment (100)	1477	3892

EAST FORK WHITE SUBBASIN PLAN

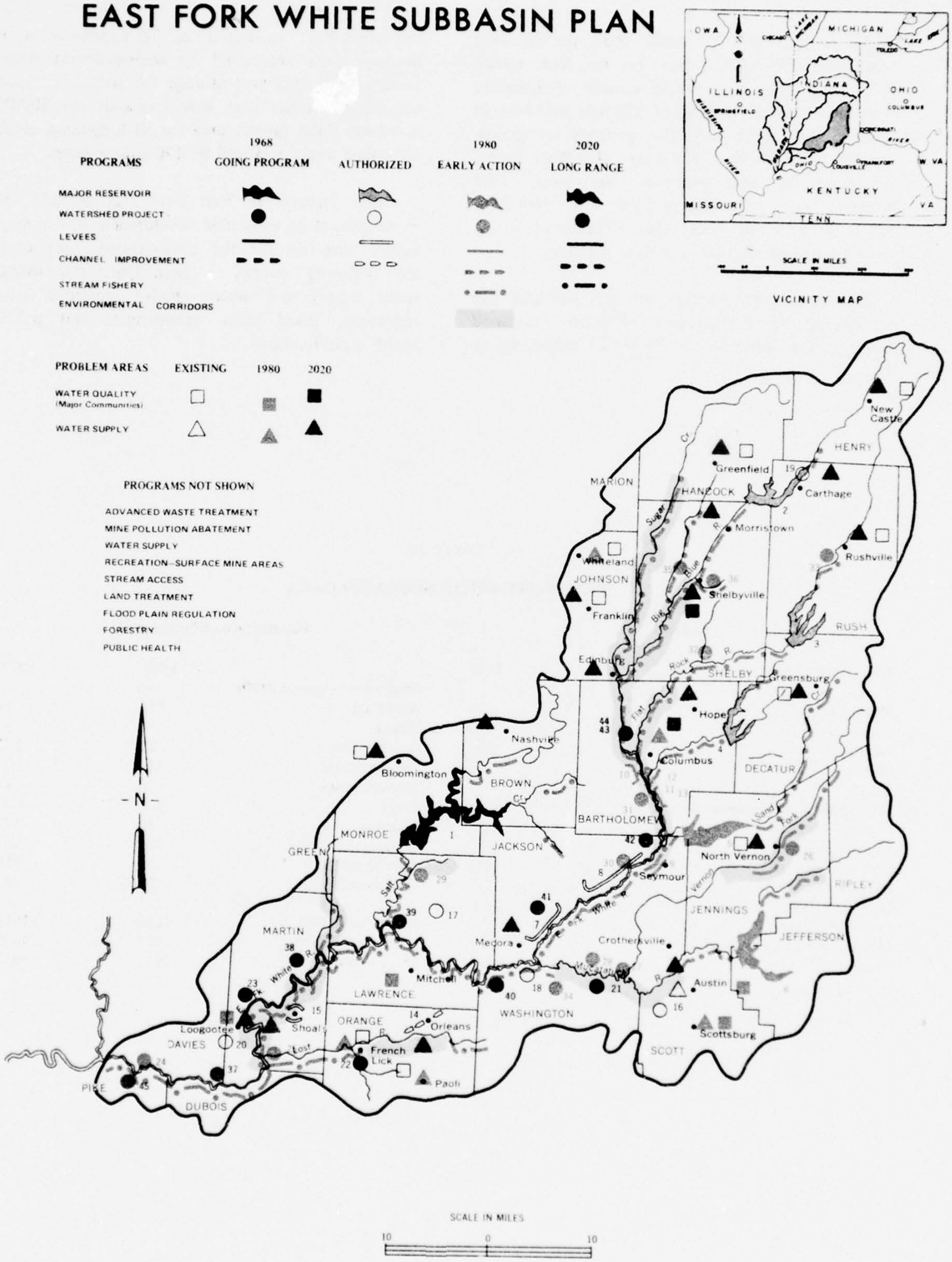


FIGURE 105

TABLE 80

EAST FORK SUBBASIN – PLAN FEATURES AND FINANCIAL DATA

Project or Program	Subbasin Project No 1/	Purpose 2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Totals ($1,000)
EARLY ACTION AND LONG RANGE STRUCTURAL MEASURES						
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
Major Reservoir Projects						
Big Blue	2	FC,R			34,982	
Downeyville	3	FC,R,WS			41,421	
Clifty Creek	4	FC,R,WS,WQ			21,268	
Monroe	1	FC,R,WS,WQ			14,836	112,507
Upstream Watershed Projects						
Elk Creek	21	FC,I,FW			861	
French Lick Creek	22	FC,FW			1,084	
Boggs Creek	23	FC			689	
Stucker Fork	16	FC			3,900	
Twin Rush Creek	18	FC,WS,R			1,184	
Dewitt Creek	17	FC			339	
Upper Big Blue River	19	FC,WS,WQ,R			10,928	
West Boggs Creek	20	FC,R			2,136	21,121
Local Protection Projects						
East Fork Levee Unit 2 3/	7	FC				
East Fork Levee Unit 3 3/	8	FC				
Shoals Local Protection 3/	15	FC				
Orleans Local Protection	14	FC			646	646
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Major Reservoir Projects						
Deputy	6	FC,R,WQ	27,294	2,306	29,600	
Azalia	5	FC,R,WQ	22,282	7,018	29,300	59,900
Upstream Watershed Projects						
Aikman Creek	24	FC,D	592	178	770	
Lost River	25	FC,R,WS	5,257	2,455	7,712	
Upper Vernon Fork	26	FC,R,WS;WQ	4,050	4,322	8,372	
Lower Vernon Fork	27	FC,R,D	5,727	2,490	8,217	
Pond Creek	28	FC,R,D	792	603	1,395	
Little Salt Creek	29	FC	576	144	720	
White Creek - Beatty Ditch	30	FC,R,D	4,180	2,151	6,331	
Denios Creek	31	FC,R	675	530	1,205	
Lewis Creek	32	FC,D	886	370	1,256	
Upper Big Flat Rock River	33	FC,WS,FW,D	2,128	1,697	3,825	
Delaney Creek	34	FC,I,R	997	484	1,481	
Brandywine Creek	35	FC,D	1,073	337	1,410	
Little Blue River	36	FC	1,041	260	1.301	43,996
Local Protection Projects						
Wiemeyer	12	FC	165	30	195	
Beatty	11	FC	1,185	125	1,310	

TABLE 80

EAST FORK SUBBASIN – PLAN FEATURES AND FINANCIAL DATA (CONTINUED)

Project or Program	Subbasin Project No 1/	Purpose 2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Totals ($1,000)
Levee Unit 5	13	FC	1,250	123	1,373	
Columbus West	10	FC	1,190	185	1,375	
Levee Unit 17	9	FC	470	100	570	4,823
Advanced Waste Treatment	—	WQ	—	9,800	9,800	9,800
Water Supply	—	WS	—	3,500	3,500	3,500
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Upstream Watersheds						
Sugar and Slate Creeks	37	FC,R	723	467	1,190	
Sulphur Creek	38	FC,R	602	490	1,092	
Guthrie Creek	39	FC,R,WS	1,407	949	2,356	
Buffalo Creek	40	FC,R	663	534	1,197	
McHargue Ditch	41	FC,D	113	39	152	
John Thompson Ditch	42	FC	119	30	149	
Big Slough	43	FC	177	44	221	
Youngs Creek	44	FC	388	97	485	
Bear Creek	45	FC,R	328	311	639	
Advanced Waste Treatment	—	WQ		12,000	12,000	12,000
Water Supply	—	WS		21,000	21,000	21,000
EARLY ACTION AND LONG RANGE ENVIRONMENTAL REGIONAL AND SOCIAL MANAGEMENT AND OTHER MEASURES						
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Environmental Corridors	—	E,R,FW	6,120	6,120	12,240	12,240
Stream Fishery	—	E,R,FW	1,746	1,746	3,492	3,492
Access Sites	—	E,R,FW	360	360	720	720
Flood Plain Management	—	FC,E	302	—	302	302
Use of Surface Mined Areas for Recreation	—	E,R,FW	775	775	1,550	1,550
Land Treatment	—	E,SC	24,073	23,863	47,936	47,936
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Land Treatment	—	E,SC	10,507	10,415	20,922	20,922
Flood Plain Management	—	FC,E	490	—	490	490
Use of Surface Mined Areas for Recreation	—	E,R,FW	2,200	2,200	4,400	4,400
TOTALS 4/ - Federal First Costs			132,903			
Non-Federal First Costs				120,648		
Subbasin Grand Total					387,825	387,825

1/ Numbers refer to figure 105
2/ Purpose index - see table 66
3/ Authorized but not considered a part of Comprehensive Plan
4/ Subbasin Plan does not include basinwide measures

WEST FORK SUBBASIN

The West Fork rises in southeastern Randolph County near Winchester, Indiana and flows about 60 miles toward the center of Indiana and thence southwesterly through Indianapolis and southwestern Indiana to its junction with the Wabash at Mt. Carmel, Illinois. The subbasin is entirely within Indiana.

A total of 5,603 square miles are drained by this comparatively long and narrow watershed. The stream elevation is about 400 feet mean sea level (m.s.l.) at the mouth and ranges to the highest area in Indiana, about 1,250 feet m.s.l. Length of the West Fork, from the Wabash River to the headwaters, is about 371 miles. Principal tributaries of the stream are Eel River, Eagle Creek, Fall Creek and White Lick Creek with drainage areas of 1,208; 210; 318; and 291 square miles respectively. A map of the subbasin is presented as figure 107.

Climatological data for the subbasin shows an average annual precipitation of 39 inches in the headwaters and 43 inches in the lower half of the watershed. Mean daily minimum January temperatures range from 21 degrees F. in the headwater area to 26 degrees F. near the mouth of the stream. Mean daily maximum temperature for July is 90 degrees F. in the lower half of the subbasin.

The West Fork White River subbasin is the most populous of the eight subbasins studied, with a 1960 population of about 1.25 million. By 2020, the population is expected to increase some 87% to a figure of 2.3 million. The Cities of Indianapolis, Muncie, Anderson, New Castle, Shelbyville and Elwood make up 49 percent of the total subbasin population while the total urban-rural mix in 1960 was 69 percent and 31 percent respectively. The greatest population increase is forecast for Hendricks County, which is projected to grow to 101,000 population by 2020, an increase of 223 percent. The least growth is forecast for Owen County, which is expected to remain at about the present population of 10,800 for the same period of time.

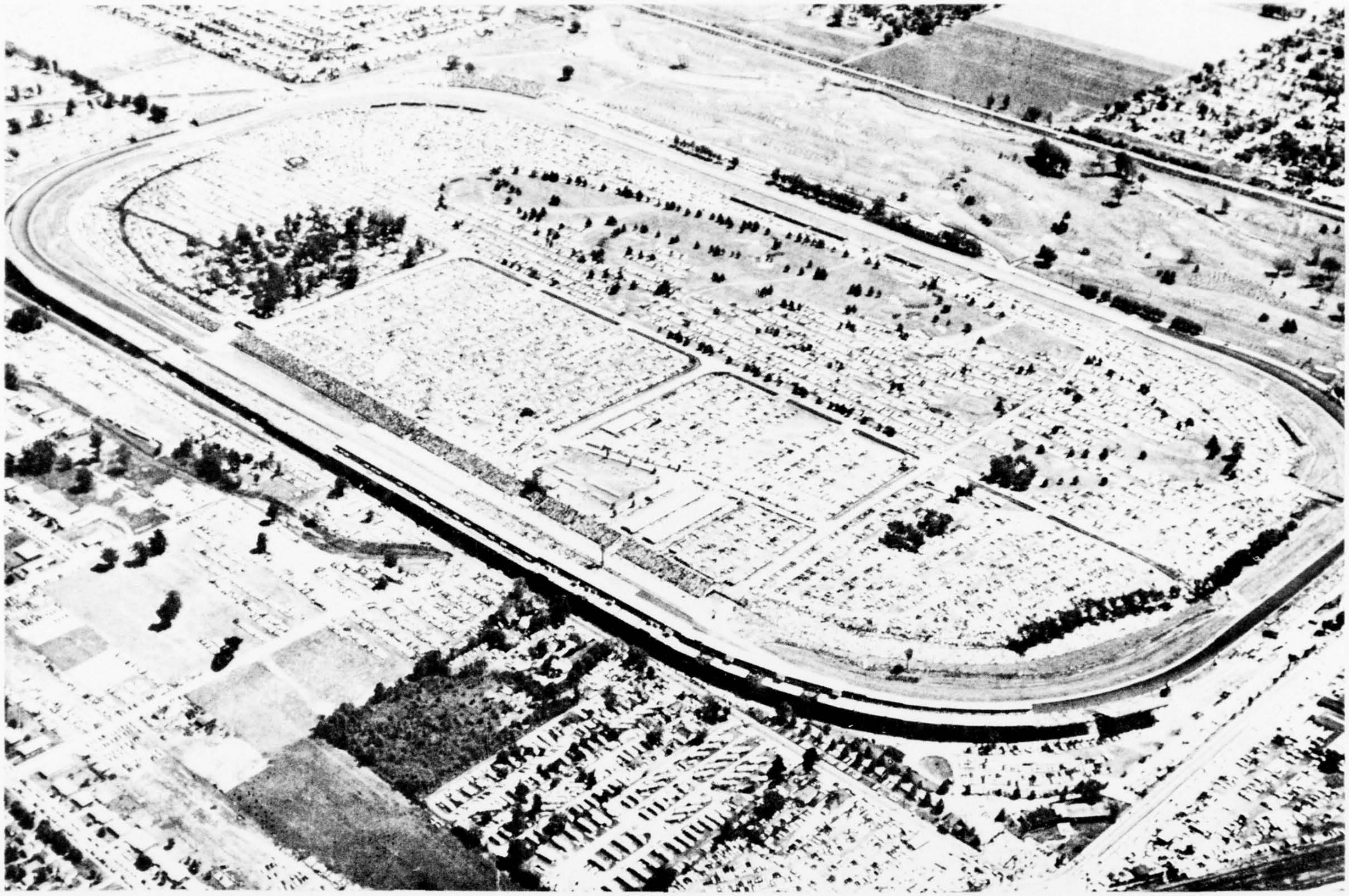
Approximately 49 percent of the labor force of 504,000 is employed in manufacturing and service occupations. Agriculture is projected to continue as a major industry in terms of dollar output, although employment in this area will drop significantly. The West Fork Subbasin, specifically the metropolitan Indianapolis area, is projected to continue as the centrally located economic nucleus of the Wabash River basin for the next half century.

The West Fork Subbasin, being the most populous of the subbasin studied and thus generating the most economic activity, will put increasingly greater demands on the land and water resources of the area. Urgent demands, especially in the metropolitan Indianapolis area, for industrial-municipal water, flood control, pollution abatement, waste disposal, and outdoor recreation, will call for greater and more efficient utilization of the water within the basin which is the most important of all natural resources. Accordingly, this subbasin has been carefully investigated for reliable sources of additional water supplies to meet the foreseeable needs to the year 2020. Of the 39 areas for which demands were projected, only 7 will have difficulty in meeting their expected needs through the year 2020 from locally available ground and/or surface resources. The problems concerning these areas are discussed in Appendix F.

The plan of development for the West Fork Subbasin includes the constructed Cagles Mill Reservoir and the Big Walnut Reservoir, which was conditionally authorized for construction by the Flood Control Act of 1968, pending a final decision by the President –– a special committee is now investigating the effects, if any, of the project on the ecological area in the upper reaches of the reservoir.

Local protection projects have been completed in Daviess County (Levee Unit 8), at Muncie, and a portion of the overall local protection plan at Indianapolis has been completed. There are 12 other local protection projects presently authorized for construction within the subbasin. By 31 December 1968, four small watershed projects were also authorized for construction in the subbasin.

The early action phase of the comprehensive plan as presented in this report, recommends the construction of two additional multipurpose Corps of Engineer Reservoirs and fourteen small watershed projects. The fourteen small watershed projects would include land treatment measures over much of the 1,002 square miles of total project area and



(Official Indianapolis Motor Speedway Photo)

FIGURE 106. INDIANAPOLIS MOTOR SPEEDWAY – WEST FORK SUBBASIN

furnish a total multipurpose storage of 137,000 acre-feet. Structural control would be achieved for 289 square miles.

One of the most urgent and pressing water resources development needs within the basin is for additional water to meet the projected demands for the urban Indianapolis complex in the decades ahead to 2020. With a population increase of 44 percent from 1950 to 1970 and an even greater percentage in per capita consumption of water, the total demand in the Marion County area is presently nearing 100 MGD. To meet this and other important early needs, such as pollution abatement, flood control and general outdoor recreation, a multiple purpose reservoir is proposed on Fall Creek near the present Geist Reservoir. Parker Reservoir is recommended for early action construction on the main stem of White near Parker City to meet projected water needs for the Muncie and Anderson areas, which will require, by 2020, an additional 30 MGD supply over and above that supplied by developable ground water sources.

The long range phase of the program for West Fork Subbasin concentrates on nine additional small watershed projects which would include 470 square miles of total project area, control 78 square miles of drainage area behind structures and provide 50,500 acre-feet of multipurpose storage. The Upper Martinsville Reservoir is also recommended for construction under the long range phase of the program. It would be located on the main stem of White just above the mouth of White Lick Creek in Morgan County. This project would yield significant flood control benefits for the West Fork of White River and the Lower Wabash River and provide improvements in the stream characteristics during the summer and fall dry seasons.

Included in the comprehensive plan for the subbasin are the general programs of development and preservation for the environmental corridors, stream fishery access, municipal and industrial water supply and water quality measures, land treatment, flood plain management and public health considerations.

TABLE 81

WEST FORK SUBBASIN DATA

General	
Area (square miles)	5603
States (percent)	
Illinois	0
Indiana	100
Ohio	0
Physiographic areas (percent)	
Tipton Till Plain	55.0
Wabash Lowlands	21.0
Crawford Upland	12.1
Mitchell Plain	4.4
Norman Upland	7.5
Total	100.0

Population and Employment	1960	2020
Employment sectors (100)		
Agriculture	186	61
Mining	22	30
Construction	244	541
Manufacturing	1599	2464
Transportation	324	487
Trade	902	1849
Finances	222	659
Services	862	2045
Government	254	819
Non-classified	241	297
Population (100)	12507	23414
Labor Force (100)	5039	9773
Employment (100)	4855	9252

WEST FORK WHITE SUBBASIN PLAN

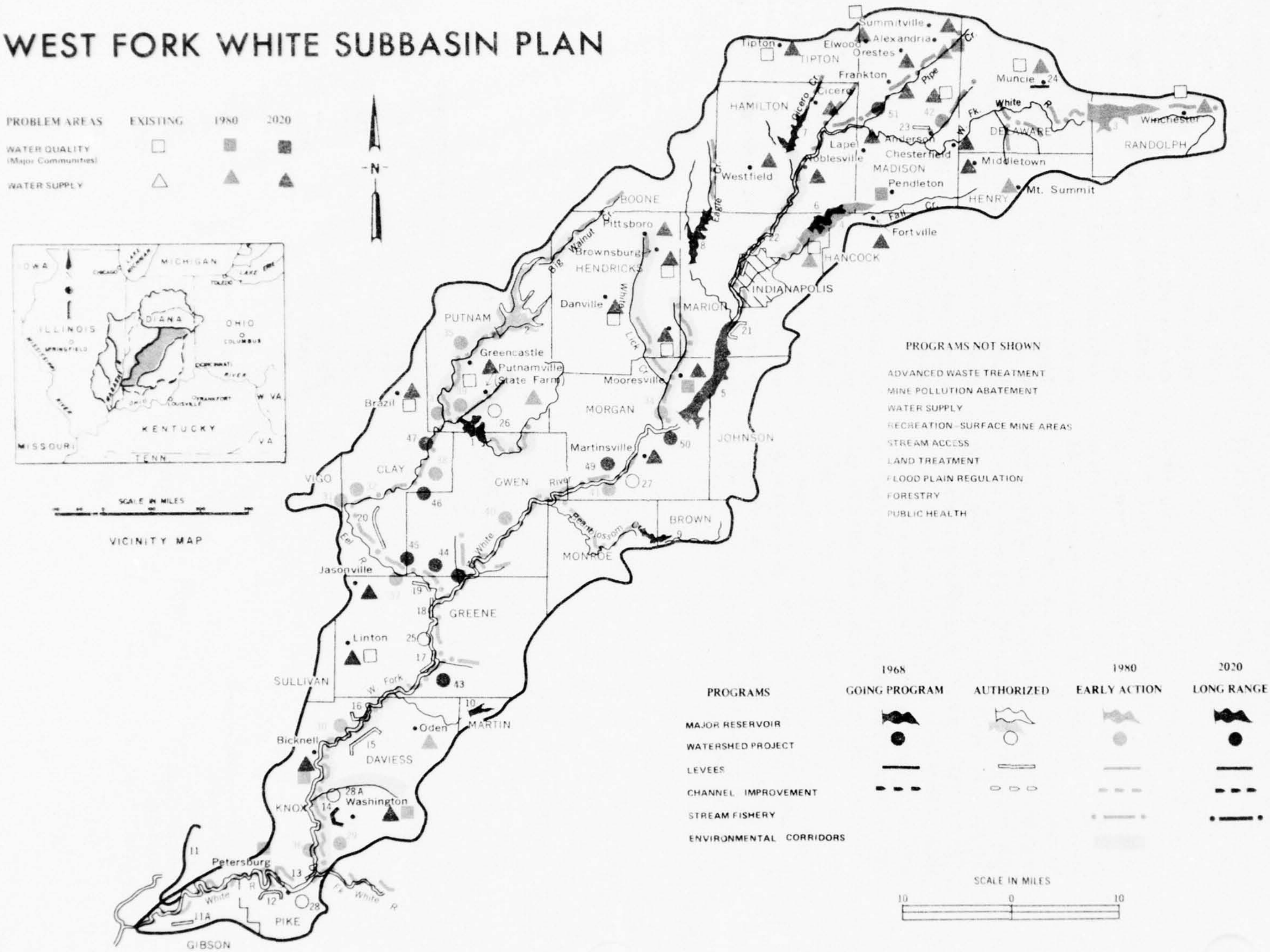


FIGURE 107

TABLE 82
WEST FORK SUBBASIN – PLAN FEATURES AND FINANCIAL DATA

Project or Program	Subbasin Project No[1/]	Purpose[2/]	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Totals ($1,000)
EARLY ACTION AND LONG RANGE STRUCTURAL MEASURES						
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
Major Reservoir Projects						
Cagles Mill	1				4,256	
Big Walnut	2				40,864	45,120
Upstream Watershed Projects						
Prairie Creek (Daviess)	28a	FC,R			3,189	
Lattas Creek	25	FC			1,888	
Mill Creek	26	FC,R			8,655	
Indian Creek	27	FC,R			4,010	
Prides Creek	28	FC,R			1,541	19,283
Local Protection Projects						
Levee Unit 17	11a	FC			1,254	
Levee Unit 1[3/]	12	FC				
Levee Unit 7[3/]	13	FC				
Levee Unit 8[3/]	14	FC				
Shufflebarger Levee[3/]	15	FC				
McGinnis Levee[3/]	16	FC				
Levee Unit 9[3/]	17	FC				
Levee Unit 10[3/]	18	FC				
Eel Levee Unit 1[3/]	19	FC				
Eel Levee Unit 2[3/]	20	FC				
Fletcher, Sunshine Gardens Levee[3/]	21	FC				
Indianapolis-White River and Fall Creek (Channel)	22	FC			13,630	
Anderson Local Protection[3/]	23	FC				
Muncie Local Protection	24	FC			908	15,792
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Major Reservoir Projects						
Parker	3	FC,R,WQ,Ws	31,884	11,916	43,800	
Fall Creek (Highland)	4	FC,R,WQ,WS	32,833	27,767	60,600	104,400
Upstream Watershed Projects						
Veale Creek	29	FC,R	687	320	1,007	
Black Creek	30	FC,R,WQ,D	1,992	626	2,618	
Lagoon Ditch, Wabash and Erie Canal	37	FC	480	120	600	
Splunge Creek	31		—	—		—
Birch Creek	32	FC,WQ	939	134	1,073	
Jordan Creek	38	FC,R	927	603	1,530	
Croys Creek	33	FC,R	983	614	1,597	
Deer Creek	39	FC,R	940	803	1,743	
Little Walnut Creek	35	FC,R	996	530	1,526	
Rattlesnake Creek	40	FC,R	823	680	1,503	
Bryant Creek	41	FC,R	229	181	410	
Whitelick Creek	34	FC,R,WQ	3,365	1,624	4,989	
Killbuck Creek	42	FC,D	611	252	863	
Wilson Creek	36	FC,R,WQ,WS	368	310	678	20,137

TABLE 82

WEST FORK SUBBASIN – PLAN FEATURES AND FINANCIAL DATA (CONT'D)

Project or Program	Subbasin Project No[1/]	Purpose[2/]	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
Advanced Waste Treatment	—	WQ	—	28,500	28,500	28,500
Water Supply	—	WS	—	2,500	2,500	2,500
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Major Reservoir Projects						
Upper Martinsville	6	FC,R,WQ	54,218	4,782	59,000	59,000
Upstream Watershed Projects						
Doans Creek	43	FC,R	527	398	925	
Lick Creek	44	FC,R	1,019	488	1,507	
Pond Creek	45	FC	36	9	45	
Six Mile Creek	46	FC,R	548	273	821	
Hog-McIntyre	47	FC,R	435	373	808	
Fish Creek	48	FC,R	1,498	1,061	2,559	
Burkhart Creek	49	FC,R	300	274	574	
Clear Creek	50	FC,R	329	314	643	
Pipe Creek	51	FC,R	No Data Available			7,882
Advanced Waste Treatment	—	WQ	—	52,000	52,000	52,000
Water Supply	—	WS	—	48,000	48,000	48,000
EARLY ACTION AND LONG RANGE ENVIRONMENTAL REGIONAL AND SOCIAL MANAGEMENT AND OTHER MEASURES						
Environmental Corridors	—	E,R,FW	3,750	3,750	7,500	7,500
Stream Fishery	—	E,R,FW	1,521	1,521	3,042	3,042
Access Sites	—	E,R	260	260	520	520
Flood Plain Management	—	FC,E	463	—	463	463
Use of Surface Mined Areas for Recreation	—	E,R,FW	2,070	2,070	4,140	4,140
Land Treatment	—	E,SC	28,716	28,465	57,181	57,181
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Land Treatment	—	E,SC	11,775	11,671	23,446	23,446
Flood Plain Management	—	FC,E	819		819	819
Use of Surface Mined Areas for Recreation	—	E,R,FW	5,850	5,850	11,700	11,700
TOTALS[4/] - Federal First Costs			192,191			
Non-Federal First Costs				239,039		
Subbasin Grand Total					511,425	511,425

1/ Numbers refer to figure 107
2/ Purpose index - see table 66
3/ Authorized but not a part of Comprehensive Plan
4/ Subbasin Plan does not include basinwide measures

UPPER WABASH SUBBASIN

This portion of the Wabash Basin contains 7,267 square miles, making it the largest of the subbasins studied. Geographically, it is that portion of the Wabash Basin lying upstream from Lafayette, Indiana, and extending to the uppermost portion of the mainstem headwaters near Fort Recovery in Mercer County, Ohio. Length of the Wabash for this subbasin is about 165 miles and maximum width, on a north-south line through Peru, is about 75 miles. Major tributaries are the Tippecanoe, Eel, Salamonie and Mississinewa Rivers and Wildcat Creek which drain a total of 69 percent of the area. A map illustrating the subbasin is presented as figure 109.

The topography of the Upper Wabash Subbasin is flat to gently rolling. It has been entirely glaciated by both the Wisconsin and Illinoian glaciers and is traversed by several low terminal moraines. Glacial outwash deposits of the Tipton till plain furnish an abundance of ground water and wells typically yield 100-500 GPM from bedrock aquifers.

Temperaturesfor the Upper Wabash Subbasin range from a mean daily maximum of 88 degrees F. in July to a mean daily minimum of 20 degrees F. in January. Annual precipitation ranges from 36 inches in the northern portion of the subbasin to 39 inches in the southern portion.

Major urban centers in the Upper Wabash Subbasin are Lafayette, Logansport, Peru, Wabash, Huntington, Kokomo, Frankfort, Marion and Warsaw. The total population of this subbasin is 675,000 (1960), and it is projected to double to 1,370,000 by 2020. The largest increases are projected for Grant, Howard and Tippecanoe Counties while the smallest is expected for Jay County.

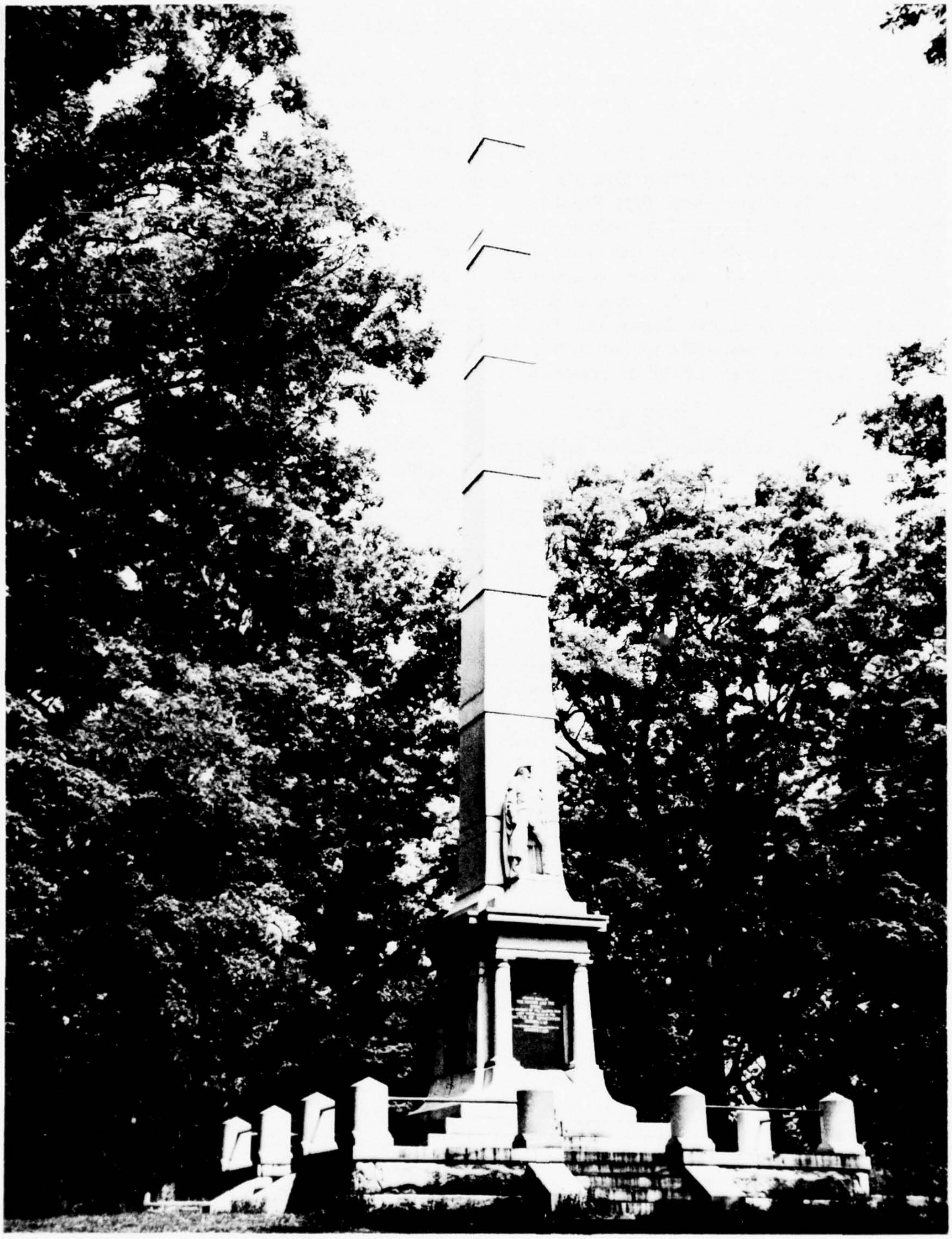
Large scale, highly mechanized grain farming is an important sector of the subbasin's total economy and is projected to continue as an important industry, although employment in agriculture is forecast to follow the national trend and decline to one-half the present total over the next fifty years. The majority of employment is concentrated in the manufacturing, trade and services industries which accounted for 73% of the total subbasin employment in 1960. Total employment is projected to increase from 254,000 in 1960 to 556,000 by 2020.

Needs for proper and efficient management of soil and water resources have become very important in this subbasin due to the scale and volume of agriculture production, and because the excess runoff water must travel over 300 miles from Lafayette to the mouth of the Wabash, affecting many people on its long journey. The plan of development to 31 December 1968 includes the constructed Huntington, Salamonie and Mississinewa Reservoirs, which control a total of 2,069 square miles or 28% of the drainage area above Lafayette. Lafayette Reservoir is authorized for construction on Wildcat Creek near Lafayette, Indiana; it would control 787 square miles.

A total of three small watershed projects were authorized for construction under Public Law 566 and one was completed by 31 December 1968. Additionally, a local protection project was authorized for Marion, Indiana, by the Flood Control Act of 1968; the Deer Creek Levee, an agricultural levee near Delphi, Indiana, was authorized by the Flood Control Act of 1938. Also at Delphi, a local protection project was completed in 1951, which protects the city against a recurrence of the maximum flood of record, March 1913.

The early action plan as presented in this report, concentrates on development of small watershed projects, administered under Public Law 550. There are sixteen projects proposed for construction under the early action phase of development, which would control a total of 295 square miles and provide storage for all uses amounting to 78,230 acre-feet. Total project area would be 2,294 square miles. Improvements included for the more general or basinwide development and preservation measures are the environmental corridors, stream fishery access, municipal and industrial water supply and water quality measures, land treatment, flood plain management and public health considerations.

There are eleven small watershed projects, consisting mainly of channel improvements, and four major, multipurpose reservoirs proposed for the long range phase of the Comprehensive Plan for the Upper Wabash Subbasin. The major reservoirs considered for possible long range construction are Deer Creek near Delphi; Denver on Eel River near Denver; Pipe Creek near Grissom AFB and Upper Delphi on the main stem above Delphi.



(Courtesy of Indiana Department of Natural Resources)

FIGURE 108. TIPPECANOE BATTLEFIELD STATE MEMORIAL – UPPER WABASH SUBBASIN

TABLE 83

UPPER WABASH SUBBASIN DATA

General

Area (square miles)	7267
States (percent)	
Illinois	0
Indiana	96
Ohio	4
Physiographic areas (percent)	
Tipton Till Plain	68.1
Steuben Morainal Lake area	18.4
Kankakee Outwash Plain	13.5
Total	100.0

Population and Employment

	1960	2020
Employment sectors (100)		
Agriculture	275	102
Mining	66	33
Construction	115	291
Manufacturing	841	1631
Transportation	144	282
Trade	419	1068
Finances	65	243
Services	463	1493
Government	108	310
Non-classified	87	110
Population (100)	6750	13704
Labor Force (100)	2621	5903
Employment (100)	2536	5563

UPPER WABASH SUBBASIN PLAN

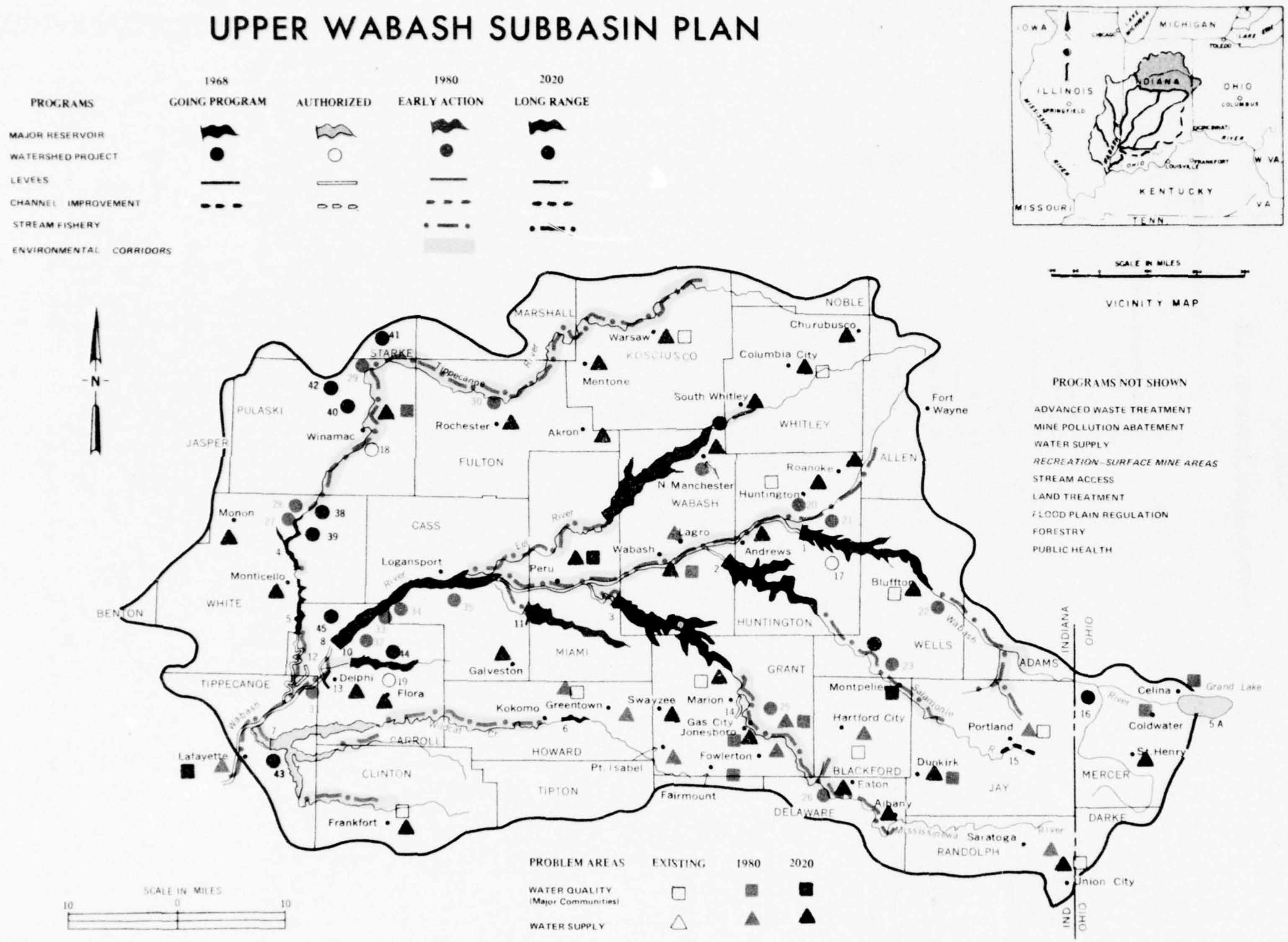


FIGURE 109

TABLE 84
UPPER WABASH SUBBASIN – PLAN FEATURES AND FINANCIAL DATA

Project or Program	Subbasin Project No 1/	Purpose 2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Totals ($1,000)
EARLY ACTION AND LONG RANGE STRUCTURAL MEASURES						
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
Major Reservoir Projects						
Huntington	1	FC,R			19,432	
Salamonie	2	FC,R			16,403	
Mississinewa	3	FC,R,WQ			23,739	
Lafayette	7	FC,R			42,743	102,817
Upstream Watershed Projects						
Upper Wabash - Ohio	16	FC,D			N.A.	
Rock Creek - Wells County	17	FC,D			5,345	
Mill Creek - Fulton County	18	FC,D			937	
Bachelor Run	19	FC,D			1,051	7,333
Local Protection Projects						
Deer Creek - Prairie Levee 3/	12	FC				
Delphi Local Protection	13	FC			162	
Marion Local Protection	14	FC			1,560	1,722
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Upstream Watershed Projects						
Clear Creek	20	FC,D	310	167	477	
Little River	21	FC,D,R,WQ	3,767	773	4,540	
Buckeye Hoosier	22	FC,D,R,WQ	6,807	2,873	9,680	
Salamonie River	23	FC,D,R	3,435	911	4,346	
Pony Creek	24	FC,D	337	90	427	
Lower Mississinewa River	25	FC,R,FW	533	451	984	
Upper Mississinewa River	26	FC,D	1,997	545	2,542	
Brown Hill	27	FC,D	864	578	1,442	
Big Monon Ditch	28	FC,D	3,018	1,501	4,519	
House-Bartee	29	FC,D	572	222	794	
Mud Creek	30	FC,D	1,373	690	2,063	
Sugar Creek	31	FC,D,R	1,072	958	2,030	
Rock Creek	32	FC,D	753	289	1,042	
Burnetts Creek	33	FC,D	183	72	255	
Crooked Creek	34	FC,D	291	80	371	
Goose Creek	35	FC,R	—	—	—	3,5512
Advanced Waste Treatment (Indiana)	—	WQ	—	14,000		
(Ohio)				900	14,900	14,900
Water Supply (Indiana)	—	WS	—	6,550	6,500	6,550
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Major Reservoirs						
Deer Creek	10	FC,R	25,730	2,670	28,400	
Denver	9	FC,R	40,935	5,465	46,400	
Pipe Creek	11	FC,R	19,014	2,186	21,200	
Upper Delphi	8	FC,R	72,452	4,448	76,900	172,900

TABLE 84

UPPER WABASH SUBBASIN – PLAN FEATURES AND FINANCIAL DATA (CONT'D)

Project or Program	Subbasin Project No[1/]	Purpose[2/]	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
Upstream Watershed Project						
Scuffle Creek	36	FC,D	122	57	179	
Eel River	37	FC	No data available			
Timmons Ditch	38	FC,D	148	80	228	
Ackerman Ditch	39	FC,D	107	58	165	
Quigley Marsh Ditch	40	FC,D	87	47	134	
Fell Taylor Ditch	41	FC,D	70	38	108	
Chapman Ditch	42	FC,D	34	18	52	
South Fork Wildcat Creek	43	FC,D	No data available			
Deer Creek	44	FC,D	2,676	2,420	5,096	
Pleasant Run Creek	45	FC,D	68	36	104	
Rattlesnake Creek	45	FC,D	293	157	450	6,516
Advanced Waste Treatment (Indiana)	–	WQ	–	22,000		
(Ohio)				1,000	23,000	23,000
Water Supply (Indiana)	–	WS	–	44,900		
(Ohio)				100	45,000	45,000
EARLY ACTION AND LONG RANGE ENVIRONMENTAL REGIONAL AND SOCIAL MANAGEMENT AND OTHE: MEASURES						
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Environmental Corridors (Indiana)	–	E,R,FW	7,975	7,975		
(Ohio)				0	15,950	15,950
Stream Fishery (Indiana)	–	E,R,FW	2,053	2,053		
(Ohio)				0	4,106	4,106
Access Sites (Indiana)	–	E,R,FW	442	442		
(Ohio)				0	884	884
Flood Plain Management (Indiana)	–	FC,E	311	–	311	311
Use of Surface Mined Areas for Recreation (Indiana)		E,R,FW	775	775		
(Ohio)				0	1,550	1,550
Land Treatment (Indiana)	–	E,SC	44,123	41,112		
(Ohio)				2,624	87,859	87,859
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Land Treatment (Indiana)	–	E,SC	19,266	17,951		
				1,146	38,363	38,363
Flood Plain Management (Indiana)	–	FC,E	598	–	598	598
Use of Surface Mined Areas for Recreation	–	E,R,FW	2,200	2,200	4,400	4,400
TOTALS[4/] - Federal First Costs			264,791			
Non-Federal First Costs - Indiana				187,838		
Non-Federal First Costs - Ohio				5,770		
Subbasin Grand Total					569,771	

1/ Numbers refer to figure 109
2/ Purpose index - see table 66
3/ Authorized but not a part of Comprehensive Plan
4/ Subbasin Plan does not include basinwide measures

MIDDLE WABASH SUBBASIN

The Middle Wabash Subbasin is approximately triangular in appearance and includes the 6,555 square mile drainage area located below Lafayette, Indiana, and above the mouth of White River. The main stem of the Wabash in this subbasin flows southwesterly from Lafayette toward the Illinois-Indiana state line and then flows generally south toward White River, a total distance of approximately 116 miles. The subbasin ranks second in size of the hydrologic units studied for this report. A map of the Middle Wabash Subbasin is presented as figure 111.

Temperatures, especially during the winter months, vary more for the Middle Wabash because of its north-south orientation. Mean daily January minimums range from 20 degrees F. in the north to 26 degrees F. in the south; mean daily July maximum temperatures range from 88 degrees F. to 90 degrees F. Precipitation ranges from 36 inches in the north to 42 inches in the south.

Major tributaries of the subbasin are the Vermilion River in Illinois and Sugar Creek in Indiana which have drainage areas of 1,520 square miles and 840 square miles respectively. Other tributaries are Big Pine Creek, Coal Creek, Raccoon Creek and Brouilletts Creek.

The upper half of the subbasin drains flat to gently rolling, fertile plains and the Wabash and tributary streams are well entrenched in this portion of the subbasin; in the lower portion, the stream enters the Wabash Lowlands. The Wabash in this area meanders considerably as it courses through the wide valley which was once a glacial sluiceway. Entrenchment is shallow with almost annual flooding of the adjacent, low-lying plains.

The urban area of Urbana-Champaign, Illinois, located on the northwestern rim of the subbasin, can make the somewhat tenuous claim of being the largest urban area in the Middle Wabash. Its 1960 population was 76,900. Terre Haute, Indiana, ranks second with a 1960 population of 72,500 followed by Danville, Illinois with a 1960 population of 41,800. Total population of the subbasin is projected to increase from 570,000 in 1960 to 933,000 by 2020, a 63% increase, while employment is expected to increase about 76% for the same period.

The plan of development for the Middle Wabash includes five completed local protection projects; twelve authorized local protection projects; one local protection project under construction (West Terre Huate); one completed multipurpose reservoir (Mansfield Reservoir) and the authorized multipurpose Big Pine Reservoir, for which construction is not yet started. In addition to these projects, six small watershed projects have been authorized for construction, as of 31 December 1968, in the Middle Wabash Subbasin.

For the Comprehensive Plan as presented in this report, the Coordinating Committee has recommended two major multipurpose reservoir developments for the early action phase of development. These are the Salt Fork Reservoir near Danville, Illinois, and the Crawfordsville Reservoir on Sugar Creek near Crawfordsville, Indiana. They would furnish control for 515 and 423 square miles.

The Soil Conservation Service has recommended the inclusion of eighteen small watershed projects in the early action phase for the Middle Wabash Subbasin. These projects would improve conservation practices on much of the 1,416 square miles of total project area and multipurpose storage of 155,650 acre-feet would be provided behind the 47 structures, which would furnish control of 437 square miles.

A total of twelve additional small watershed projects have been proposed for inclusion in the long range program of the Comprehensive Plan. Approximately 201 square miles of drainage area would be controlled by the structures included in these twelve projects. Total storage for all purposes in the structures would be 88,400 acre-feet and the total project area would be 708 square miles. The multipurpose Coal Creek Reservoir is also recommended for inclusion in the long-range plan. This project would be located on Coal Creek near Newport, Indiana, and would control approximately 256 square miles.

General basinwide programs of development and preservation include environmental corridors, stream fishery access, municipal and industrial water supply and water quality measures, land treatment, flood plain management and public health considerations. Reclamation of abandoned strip mined areas is an important water quality consideration in this subbasin.

(Courtesy of Indiana Department of Natural Resources)

FIGURE 110. GEORGE ROGERS CLARK STATE MEMORIAL – MIDDLE WABASH SUBBASIN

TABLE 85

MIDDLE WABASH SUBBASIN – PLAN FEATURES AND FINANCIAL DATA

Project or Program	Subbasin Project No. 1/	Purpose 2/	Federal First Costs ($1,000)	Non-Federal First Costs ($1,000)	Project First Costs ($1,000)	Totals ($1,000)
EARLY ACTION AND LONG RANGE STRUCTURAL MEASURES						
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
Major Reservoirs						
Mansfield (Indiana)	1	FC,R			6,280	
Big Pine (Indiana)	2	FC,R			24,567	30,847
Upstream Watershed Projects						
Busseron Creek (Indiana)	25	FC,WS,R			9,671	
Little Wea Creek (Indiana)	59	N.A.			N.A.	
Kickapoo Creek (Indiana)	26	FC,D			418	
Prairie Creek (Vigo County) (Indiana)	27	FC,D			787	
Little Raccoon Creek (Indiana)	28	FC,R			4,799	15,675
Local Protection Projects						
Adams 3/ (Indiana)	7	FC				
Raccoon 3/ (Indiana)	8	FC				
Lyford (Indiana)	9	FC			291	
Clinton 3/ (Indiana)	10	FC				
Conover (Indiana)	11	FC			15	
West Terre Haute (Indiana)	12	FC			1,290	
Sugar Creek 3/ (Indiana)	13	FC				
Honey Creek 3/ (Indiana)	14	FC				
Greenfield Bayou (Indiana)	15	FC			3,221	
Levee Unit 6 (Illinois)	16	FC			1,216	
Island (Indiana)	17	FC			2,094	
Tri Pond (Illinois)	18	FC			2,050	
Gill Township (Indiana)	19	FC			581	
Niblack (Indiana)	20	FC			2,574	
Russell and Allison (Illinois)	21	FC			7,365	
England Pond (Illinois)	22	FC			932	
Vincennes (Indiana)	23	FC			6,120	
Brevoort (Indiana)	24	FC			3,585	31,334
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Major Reservoirs						
Crawfordsville (Indiana)	5	FC,WS,R,WQ	24,996	3,904	28,900	
Salt Fork (Illinois)	4	FC,R,WQ	31,995	4,205	36,200	65,100
Upstream Watershed Projects						
Raccoon Creek (Illinois)	30	FC,D	1,170	349	1,519	
Snapp-Kelso (Indiana)	32	FC,R	506	428	934	
Mariah Creek (Indiana)	33	FC,D,R	969	282	1,251	
Turtle Creek (Indiana)	35	FC,R,I	928	477	1,405	
Mill Creek (Indiana)	36	FC,R	1,939	1,084	3,023	
Honey Creek (Indiana)	38	FC,R	3,249	936	4,185	
Otter Creek (Indiana)	40	FC,R	2,371	1,613	3,984	
Coal Creek (Indiana)	41	FC,R	1,269	673	1,942	

MID WABASH SUBBASIN PLAN

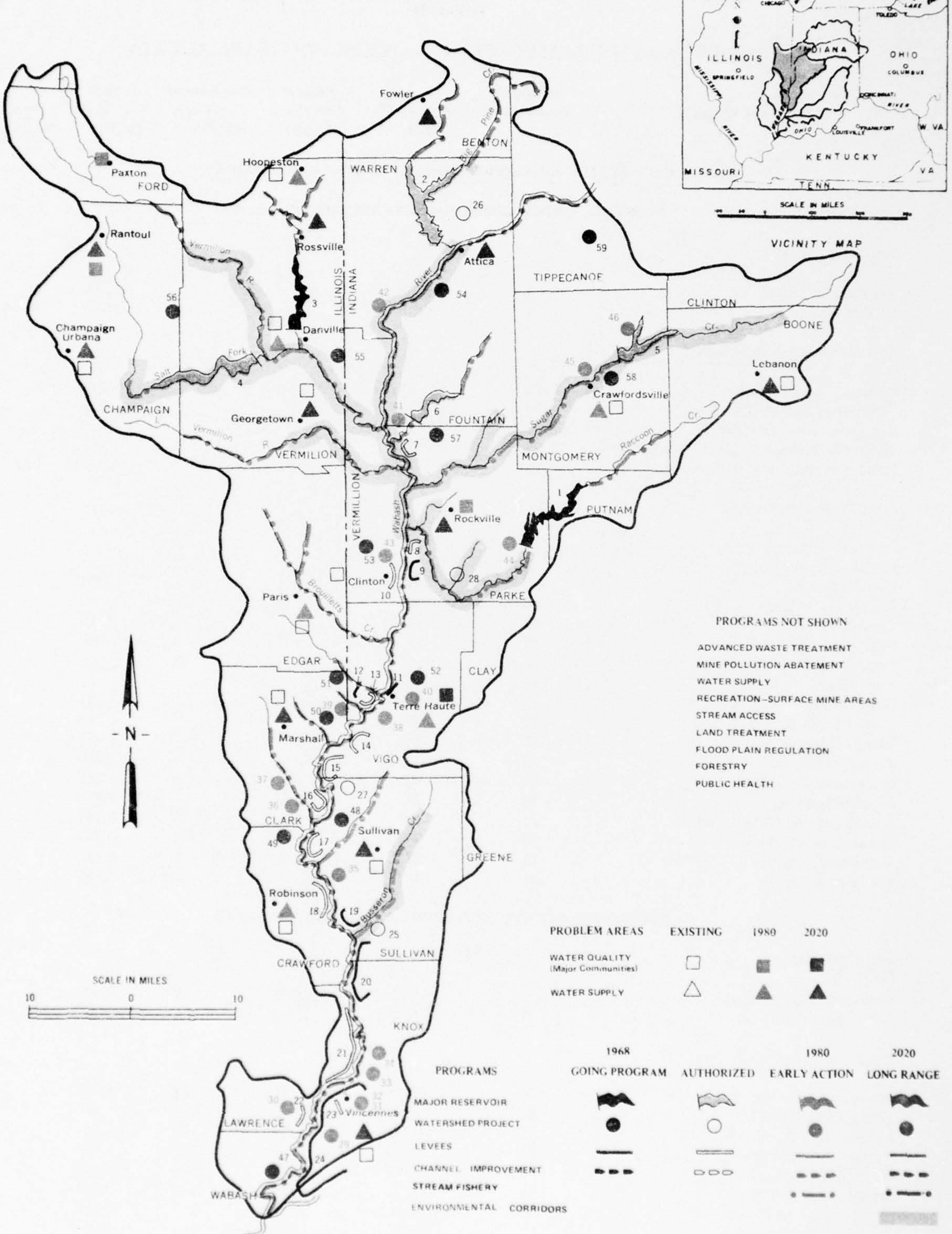


FIGURE 111

TABLE 85

MIDDLE WABASH SUBBASIN – PLAN FEATURES AND FINANCIAL DATA (CONT'D)

Project or Program	Subbasin Project No[1/]	Purpose[2/]	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
Big Raccoon Creek (Indiana)	44	FC,R,FW	1,722	714	2,436	
Jordan Creek (Indiana)	45	FC,D	585	210	795	
Lye Creek (Indiana)	46	FC,D	791	420	1,211	
Fall Creek (Indiana)	42	FC,R	193	181	374	
Vieke Ditch (Indiana)	29	FC,D	364	114	478	
City Ditch (Indiana)	31	FC,D	253	83	336	
Sugar Creek (Illinois)	39	FC,WS,WQ	875	902	1,777	
Lower Shaker Prairie (Indiana)	34	FC,D	243	70	313	
Snyder Creek (Illinois)	37	FC	262	65	327	
Feather Creek (Indiana)	43	FC,R	767	504	1,271	27,561
Advanced Waste Treatment (Illinois)	—	WQ	—	8,000		
(Indiana)				4,000	12,000	12,000
Mine Pollution Abatement (Indiana)	—	WQ	1,000	1,000	2,000	2,000
Water Supply (Illinois)	—	WS		2,300		
(Indiana)				4,220	6,520	6,520
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Major Reservoir Projects						
Coal Creek (Indiana)	6	FC,R	16,835	2,165	19,000	19,000
Upstream Watershed Projects						
Crawfish Creek (Illinois)	47	FC,D	147	37	184	
Turman Creek (Illinois)	48	FC	610	153	763	
Raccoon Creek (Illinois)	49	FC,R	778	442	1,220	
Big Creek (Illinois)	50	FC,R	1,491	935	2,426	
Clear Creek (Illinois)	51	FC,R	1,277	945	2,222	
Lost Creek (Indiana)	52	FC	341	85	426	
Norton Creek (Indiana)	53	FC,R	644	469	1,113	
Big Shawnee Creek (Indiana)	54	FC,D	460	248	708	
Coal Branch (Indiana)	55	FC	169	42	211	
Stony Creek (Illinois)	56	FC,D	370	200	570	
Sugar Mill Creek (Indiana)	57	FC,R	802	413	1,215	
Little Sugar Creek (Indiana)	58	FC,D	111	66	177	11,235
Advanced Waste Treatment (Illinois)	—	WQ		11,000		
(Indiana)				13,000	24,000	24,000
Water Supply (Illinois)	—	WS		19,000		
(Indiana)				32,000	51,000	51,000
EARLY ACTION AND LONG RANGE ENVIRONMENTAL, REGIONAL AND SOCIAL MANAGEMENT AND OTHER MEASURES						
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Environmental Corridors (Illinois)	—	E,R,FW	7,218	5,256		
(Indiana)				1,962	14,436	14,436
Stream Fishery (Illinois)	—	E,R,FW	2,359	1,353		
(Indiana)				1,006	4,718	4,718

TABLE 85

MIDDLE WABASH SUBBASIN – PLAN FEATURES AND FINANCIAL DATA (CONT'D)

Project or Program	Subbasin Project No 1/	Purpose 2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
Access Sites (Illinois)	—	E,R	403	205		
(Indiana)				198	806	806
Flood Plain Management	—	FC,E	294		294	294
Use of Surface Mined Areas for Recreation (Illinois)	—	E,R,FW	1,420	710		
(Indiana)				710	2,840	2,840
Land Treatment (Illinois)	—	E,SC	19,345	10,482		
(Indiana)				8,693	38,520	38,520
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Land Treatment (Illinois)	—		9,193	4,249		
(Indiana)				4,863	18,305	18,305
Flood Plain Management	—	FC,E	606	—	606	606
Use of Surface Mined Areas for Recreation (Illinois)		E,R,FW	4,020	2,010		
(Indiana)				2,010	8,040	8,040
TOTALS 4/ - Federal First Costs			145,340			
Non-Federal First Costs (Indiana)				91,555		
Non-Federal First Costs (Illinois)				70,086		
Subbasin Grand Total					384,837	384,837

1/ Numbers refer to figure 111
2/ Purpose index - see table 66
3/ Authorized but not a part of Comprehensive Plan
4/ Subbasin Plan does not include basinwide measures

TABLE 86

MID WABASH SUBBASIN DATA

General		Population and Employment	1960	2020
Area (square miles)	6555			
		Employment sectors (100)		
States (percent)		Agriculture	215	85
Illinois	39	Mining	26	32
Indiana	61	Construction	110	211
Ohio	0	Manufacturing	436	847
		Transportation	141	298
		Trade	384	846
Physiographic area (percent)		Finances	55	122
Tipton Till Plain	45.0	Services	476	894
Bloomington Ridged Plain	29.0	Government	182	261
Springfield Plain	6.6	Non-classified	63	87
Mt. Vernon Hill Country	2.0			
Wabash Lowlands	17.0	Population (100)	5707	9327
Crawford Upland	0.4	Labor Force (100)	2187	3907
Total	100.0	Employment (100)	2088	3683

EMBARRAS SUBBASIN

The Embarras Subbasin encompasses a total area of 2,438 square miles making it the smallest subbasin of the Wabash River in Illinois. The drainage area, from Urbana-Champaign, Illinois, southward to the mouth near Lawrenceville, is approximately 110 miles in length. Average width of the subbasin is about 25 miles. In the upper reaches of the subbasin, the stream is sluggishly fed by low gradient tributaries, such as Scattering Fork, Brushy Fork, and the Little Embarras River. A map illustrating the subbasin is presented in figure 113.

The North Fork Embarras River is the largest tributary and drains 361 square miles of the middle-eastern portion of the subbasin. Topography of the subbasin varies from hilly terrain in the upper reaches to a relatively flat terrain in the lower reaches. Due to the topographic and drainage characteristics of the watershed, runoff from moderate to severe rainfall results in frequent medium to high stage flows of prolonged duration.

Climatic data for the Embarras Subbasin shows mean daily maximum July temperatures of 89 degrees F. and mean daily minimum January temperatures of 22 degrees F. Annual precipitation ranges from 36 inches in the north to 42 inches in the south.

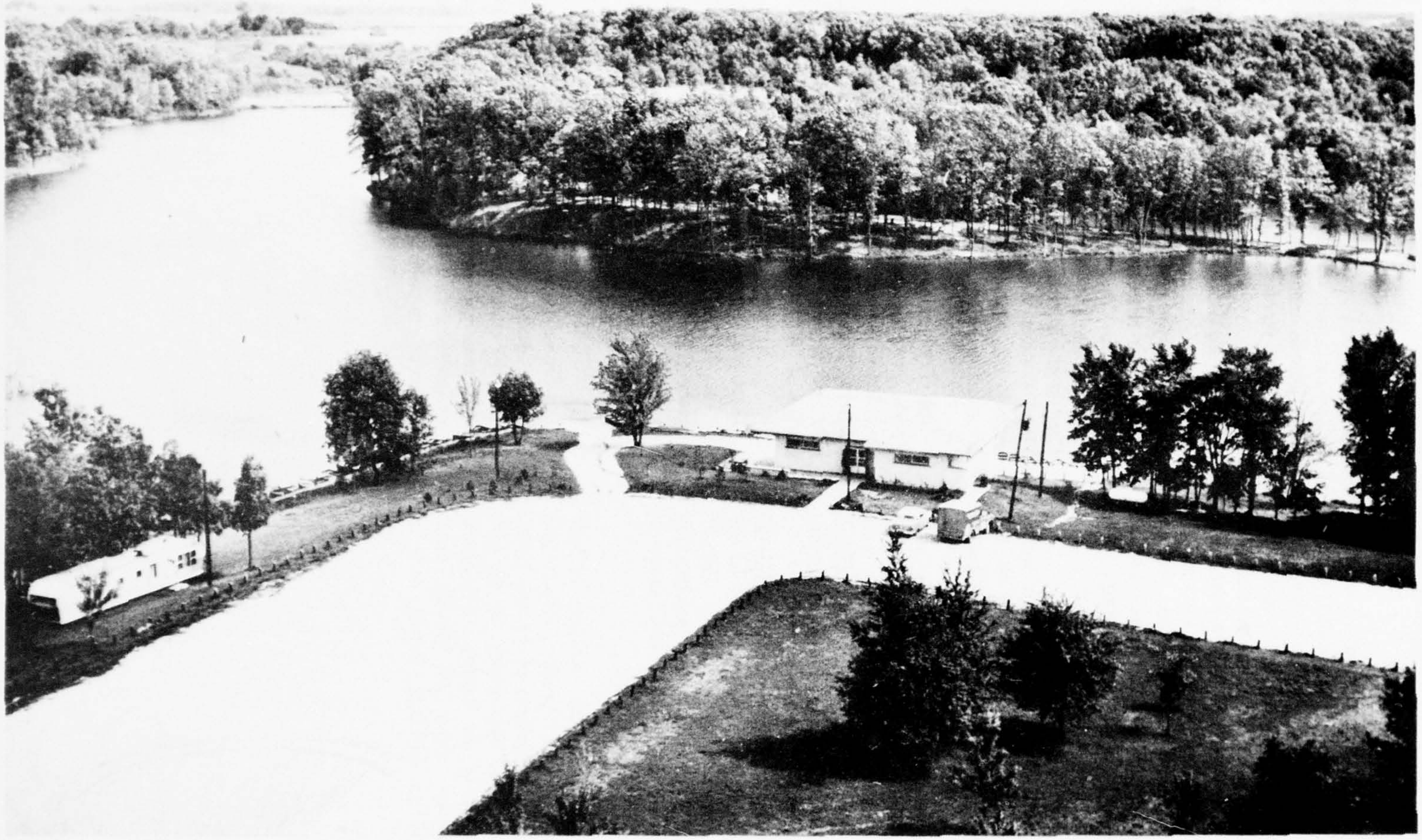
Major urban areas of the subbasin include Charleston, Newton, Lawrenceville, Toledo and Mattoon with 1960 populations of 13,600 3,100, 6,100, 1,000 and 20,000 respectively. By the year 2020, the population of the Embarras Subbasin is expected to increase about 49 percent from 122,000 in 1960 to 183,000. Employment in agriculture and related fields is expected to decline to approximately one-third the 1960 level by 2020 while jobs in manufacturing, services and trade are projected to increase significantly.

Of the eight hydrologic subbasins given detailed study in this comprehensive report, the Embarras has, under the current plan of development, the fewest water resources developments either planned or developed. The major project planned for the Embarras is the multipurpose Lincoln Reservoir near Charleston, Illinois, which was authorized by the Flood Control Act of 1965. One small watershed project on Scattering Fork was authorized for construction as of 31 December 1968.

The Comprehensive Plan as presented in this report, recommends six small watershed projects for construction under the early action phase of the program. These projects would control 351 square miles of drainage area and furnish multipurpose storage of 100,230 acre-feet.

There are four small watershed projects proposed for the Embarras Subbasin in the long range program which would control an additional 91 square miles and furnish 31,730 acre-feet of multipurpose storage. Total project area would be 236 square miles.

The Embarras plan includes the more general or basinwide development and preservation measures such as the environmental corridors, stream fishery access, municipal and industrial water supply and water quality measures, land treatment, flood plain management and public health considerations.



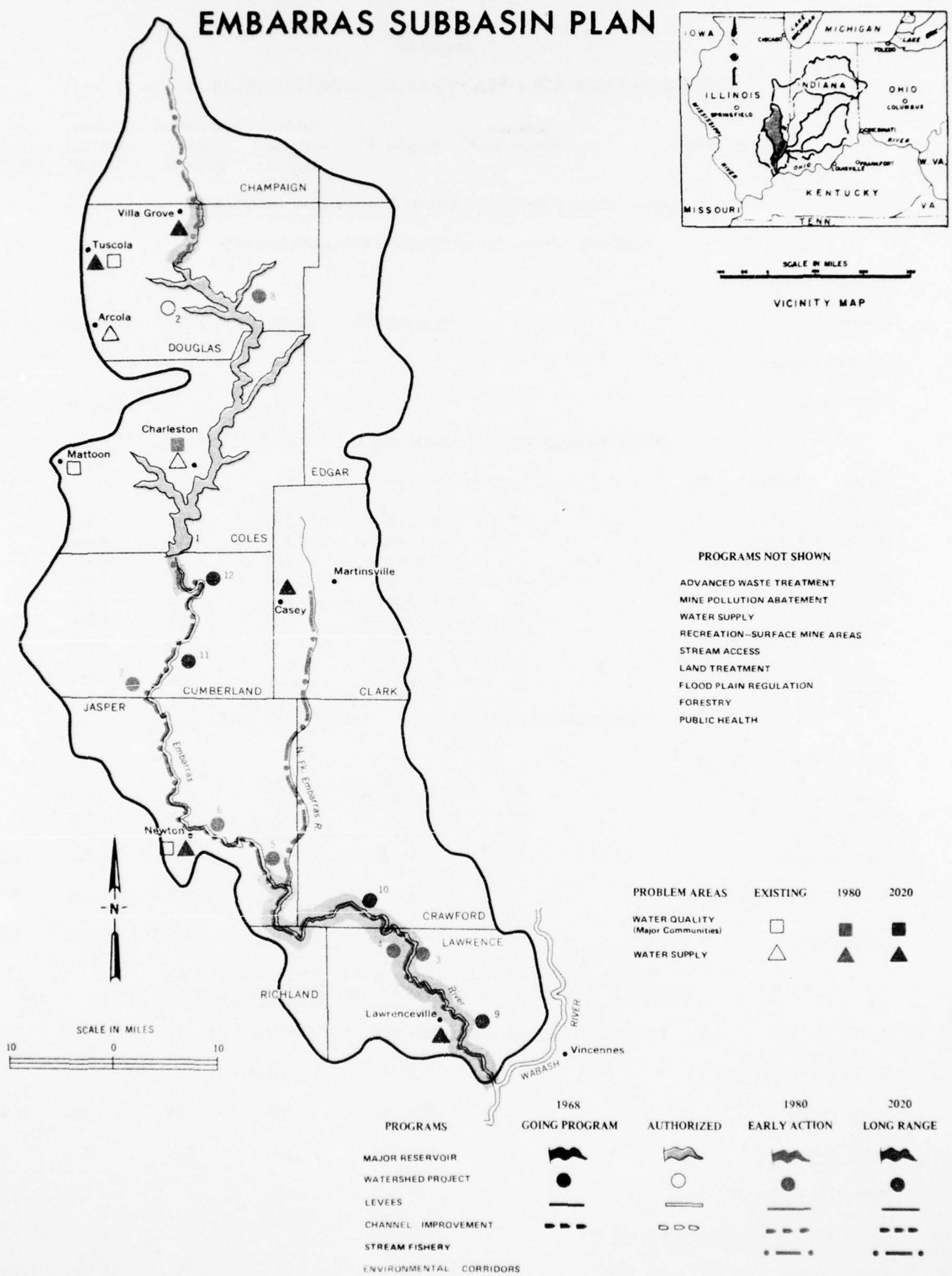
(Courtesy of Illinois Department of Conservation)

FIGURE 112. RED HILLS STATE PARK – EMBARRAS SUBBASIN

TABLE 87

EMBARRAS SUBBASIN – PLAN FEATURES AND FINANCIAL DATA

Project or Program	Subbasin Project No.1/	Purpose 2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
EARLY ACTION AND LONG RANGE STRUCTURAL MEASURES						
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
Major Reservoirs						
Lincoln	1	FC,R,WS,WQ	42,706	2,742	45,448	45,448
Upstream Watershed Projects						
Scattering Fork	2				1,376	1,376
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Upstream Watershed Projects						
Muddy Creek (17g-5)	4	FC,D,WQ	1,291	452	1,743	
Muddy Creek (17g-21)	7	FC,R,WQ,WS	2,707	1,736	4,443	
North Fork Embarras River	5	FC,R,WQ,WS	7,167	3,270	10,437	
Crooked Creek	6	FC,R	1,295	446	1,741	
Brushy-Birch Creek	3	FC,R,WQ	1,321	551	1,872	
Brushy Creek	8	FC	829	207	1,036	21,272
Advanced Waste Treatment	–	WQ	–	1,560	1,560	1,560
Water Supply	–	WS	–	750	750	750
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Upstream Watershed Projects						
Otter-Beaver-Allison Creeks	9	FC,D	950	512	1,462	
Honey Creek	10	FC,R	815	355	1,170	
Range Creek	11	FC,R	1,686	692	2,378	
Hurricane Creek	12	FC	829	208	1,037	6,047
Advanced Waste Treatment	–	WQ		2,000	2,000	2,000
Water Supply	–	WS		5,000	5,000	5,000
EARLY ACTION AND LONG RANGE ENVIRONMENTAL, REGIONAL AND SOCIAL MANAGEMENT AND OTHER MEASURES						
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Environmental Corridors	–	E,R,FW	1,385	1,385	2,770	2,770
Stream Fishery	–	E,R,FW	700	700	1,400	1,400
Access Sites	–	E,R,FW	105	105	210	210
Flood Plain Management	–	FC,E	122		122	122
Use of Surface Mined Areas for Recreation	–	E,R,FW	775	775	1,550	1,550
Land Treatment	–	E,SC	8,813	8,735	17,548	17,548



EMBARRAS SUBBASIN PLAN
IOWA
MICHIGAN
LAKE
ILLINOIS
INDIANA
OHIO
SPRINGFIELD
COLUMBUS
CHICAGO
TOLEDO
CINCINNATI
LOUISVILLE
FRANKFORT
W. VA.
KENTUCKY
MISSOURI
VA
TENN
SCALE IN MILES
VICINITY MAP
CHAMPAIGN
Villa Grove
Tuscola
Arcola
DOUGLAS
Charleston
Mattoon
EDGAR
COLES
Martinsville
Casey
CUMBERLAND
CLARK
JASPER
Embarras
N. Fk. Embarras R.
Newton
CRAWFORD
LAWRENCE
RICHLAND
River
Lawrenceville
Vincennes
WABASH
RIVER
N
SCALE IN MILES
10
0
10
PROGRAMS NOT SHOWN
ADVANCED WASTE TREATMENT
MINE POLLUTION ABATEMENT
WATER SUPPLY
RECREATION–SURFACE MINE AREAS
STREAM ACCESS
LAND TREATMENT
FLOOD PLAIN REGULATION
FORESTRY
PUBLIC HEALTH
PROBLEM AREAS
EXISTING
1980
2020
WATER QUALITY (Major Communities)
WATER SUPPLY
PROGRAMS
1968 GOING PROGRAM
AUTHORIZED
1980 EARLY ACTION
2020 LONG RANGE
MAJOR RESERVOIR
WATERSHED PROJECT
LEVEES
CHANNEL IMPROVEMENT
STREAM FISHERY
ENVIRONMENTAL CORRIDORS

FIGURE 113

TABLE 87

EMBARRAS SUBBASIN – PLAN FEATURES AND FINANCIAL DATA (CONT'D)

Project or Program	Subbasin Project No[1]	Purpose [2]	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Land Treatment	--	E,SC	3,576	3,545	7,121	7,121
Flood Plain Management	--	FC,E	294		294	294
Use of Surface Mined Areas for Recreation	--	E,R,FW	2,200	2,200	4,400	4,400
TOTALS[3] - Federal First Cost			79,566			
Non-Federal First Cost				37,184		
Subbasin Grand Total					118,868	118,868

1/ Numbers refer to figure 113
2/ Purpose index - see table 66
3/ Subbasin plan does not include basin wide measures.

TABLE 88

EMBARRAS SUBBASIN DATA

General

Area (square miles)	2438
States (percent)	
Illinois	100
Indiana	0
Ohio	0
Physiographic areas (percent)	
Bloomington Ridged Plain	46.2
Springfield Plain	41.1
Mt. Vernon Hill Country	12.7
Total	100.0

Population and Employment

	1960	2020
Employment sectors (100)		
Agriculture	68	26
Mining	11	15
Construction	23	38
Manufacturing	102	198
Transportation	36	75
Trade	78	116
Finances	11	28
Services	84	207
Government	11	30
Non-classified	11	9
Population (100)	1223	1832
Labor Force (100)	457	790
Employment (100)	435	742

(Courtesy of Illinois Department of Conservation)

FIGURE 114. STEPHEN FORBES STATE PARK – LITTLE WABASH SUBBASIN

LITTLE WABASH SUBBASIN

The Little Wabash Subbasin lies in the southwestern portion of the Wabash Basin and embraces an area of 3,209 square miles, or about 10% of the entire basin. The subbasin is relatively long and narrow and is approximately oval shaped. The long dimension of the subbasin, which trends slightly west of north, is about 120 miles while the east-west dimension is about 50 miles at the widest point. The meandering length of the river is nearly twice the length of the subbasin. The largest tributary to the Little Wabash River is Skillet Fork, which drains 1,070 square miles, or about 30% of the entire subbasin.

The Little Wabash River has its source near Mattoon and the stream flows southwardly on a steep gradient for the first forty miles, which averages about 2 feet/mile; the gradient of the lower 120 miles averages about one-half foot/mile. A map showning the subbasin is presented as figure 115 This subbasin is characterized by a flat to steeply rolling topography, with local relief varying from 100 feet near Mill Shoals to 50 feet in the area near the mouth. Because of exceptionally thin glacial deposits over much of the subbasin, ground water availability is generally limited with recharge through the fine silty drift deposits being a slow process.

Average annual precipitation for the subbasin ranges from 38 to 42 inches annually, north to south. Temperatures vary from a mean daily low of 24 degrees F. in January to a mean daily high in July of 92 degrees F.

Population of the subbasin reached a peak during the early 1900's and has steadily declined since that time. This continued decline has been largely due to an out-migration of displaced farm families; but this trend is expected to reverse as more industrial growth takes place. The total subbasin population is projected to increase from a 1960 low of 119,000 to a 2020 population of 240,000 or more.

Agriculture is the primary industry in the subbasin and employed about 15 percent of the labor force in 1960. The retail-wholesale trade businesses accounted for 19 percent of the employed labor force, while manufacturing employed 16 percent and services employed 18 percent of the labor force. Employment in these industries by 2020, other than agriculture, is expected to double for trade enterprises and triple for manufacturing and services. The role of Government as an employer is expected to be significantly more important, especially at the State and local level.

The current plan of development for the Little Wabash Subbasin includes the multipurpose Helm Reservoir on Skillet Fork and the multipurpose Louisville Reservoir on the Little Wabash River, which control drainage areas of 210 and 661 square miles respectively. These projects were authorized for construction by the Flood Control Act of 1968. In addition, Levee Units 1 and 2 are authorized on the Little Wabash in southeastern Wayne County and northern White County. The Soil Conservation Service, as of 31 December 1968, had one Small Watershed Project authorized in the subbasin.

The Comprehensive Plan for the subbasin, as developed for this report, places emphasis on small watershed projects to fulfill the demands on soil and water resources over the next half-century. For the early action phase of development, the report recommends the construction of ten PL 566 projects which would control a total of 493 square miles and provide storage for all purposes of 215,170 acre-feet.

There are thirteen additional small watershed projects proposed for development under the long range program for the Little Wabash Subbasin.These projects would control an additional 312 square miles and provide multipurpose storage of 118,500 acre-feet.

Other features of the Little Wabash Subbasin plan include more general and basinwide programs such as the environmental corridors, stream fishery access, municipal and industrial water supply and water quality measures, land treatment, flood plain management and public health considerations.

LITTLE WABASH SUBBASIN PLAN

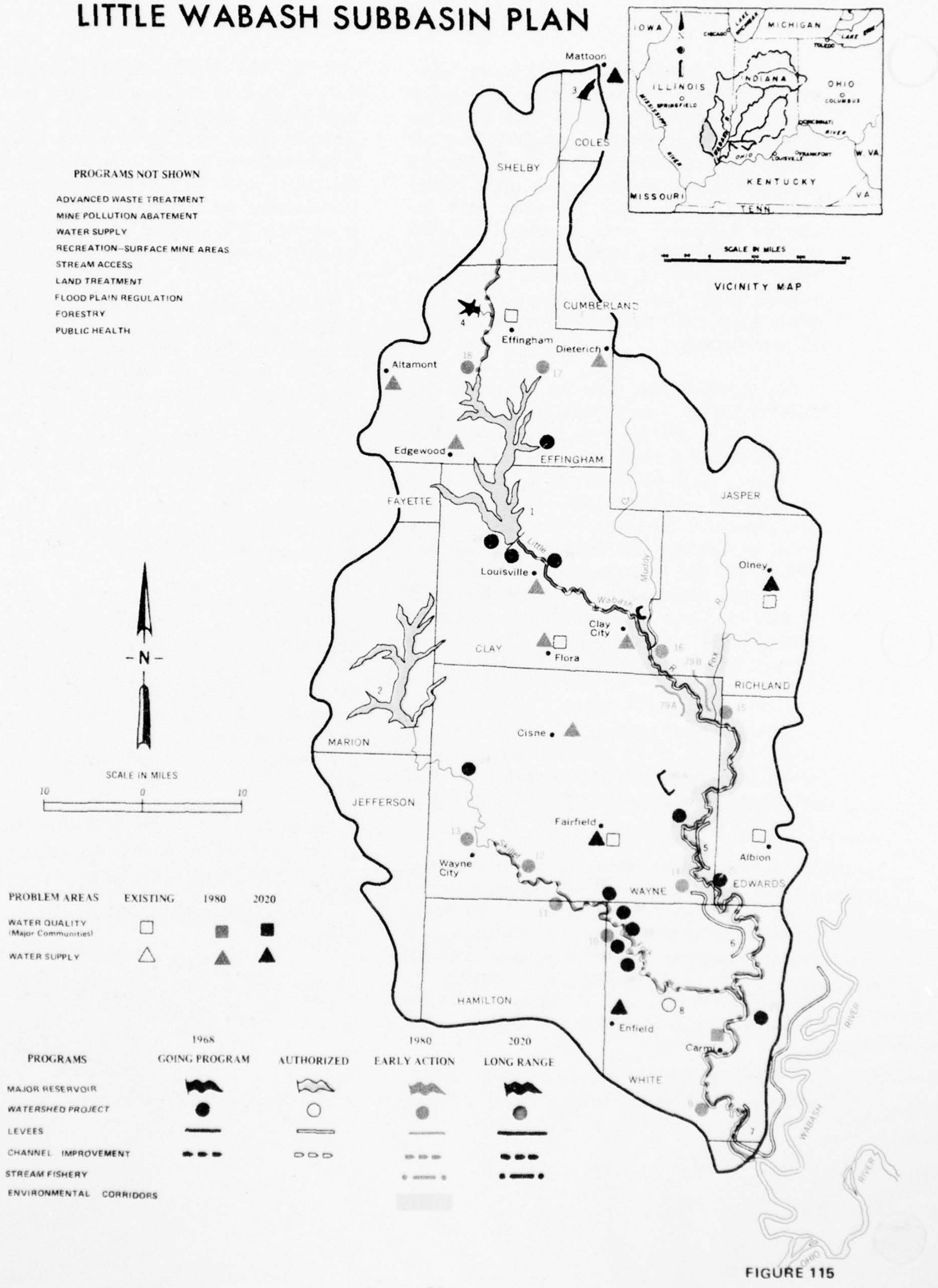


FIGURE 115

TABLE 89

LITTLE WABASH SUBBASIN – PLAN FEATURES AND FINANCIAL PLAN

Project or Program	Subbasin Project No 1/	Purpose 2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
EARLY ACTION AND LONG RANGE STRUCTURAL MEASURES						
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
Major Reservoirs						
Helm	2	FC,R			23,500	
Louisville	1	FC,R			30,900	54,400
Upstream Watershed Projects						
Seven Mile Creek	8	FC			1,992	1,992
Local Protection Projects						
Levee Unit 1 3/	6	FC				
Levee Unit 2 3/	5	FC				
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Upstream Watershed Projects						
Lick Creek	9	FC,R	747	499	1,246	
Auxier-Big Creek	10	FC,R,WS,D	2,678	2,273	4,951	
Big Mound Creek	11	FC,D	675	297	972	
Pond Creek	14	FC,R	1,068	547	1,615	
Big Muddy Creek	16	FC,R	3,638	1,374	5,012	
Dry Fork	12	FC,R,WS	1,890	774	2,664	
Horse Creek	13	FC,R,WS	2,379	1,003	3,382	
Upper Little Wabash River	18	FC,WS,WQ	2,818	528	3,346	
Fox River	15	FC,R,WS,WQ	4,077	1,026	5,103	
Salt Creek	17	FC,R	1,439	633	2,072	30,363
Local Protection Projects						
Levee Unit 7	79a	FC	670	26	696	
Levee Unit 8	79b	FC	780	30	810	1,506
Advanced Waste Treatment	—	WQ	—	4,980	4,980	4,980
Water Supply	—	WS	—	310	310	310
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Upstream Watershed Projects						
Limekiln Creek	19	FC,D	77	42	119	
Lost Creek	20	FC	390	98	488	
Beaver Creek	21	FC	188	47	235	
Prairie Creek	22	FC,D	88	47	135	
Nameless Creek	23	FC,WS	154	204	358	
Brush Creek	24	FC	998	250	1,248	
Elliott Creek	25	FC	128	32	160	
Big Creek	26	FC	No Data Available			

TABLE 89

LITTLE WABASH SUBBASIN – PLAN FEATURES AND FINANCIAL PLAN (CONT'D)

Project or Program	Subbasin Project No 1/	Purpose 2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
Elm River	27	FC,R	6,388	2,238	8,626	
Panther Creek	28	FC	602	151	753	
Crooked Creek	29	FC	320	80	400	
Dismal Creek	30	FC	453	113	566	
Bishop Creek	31	FC,WS	581	181	762	13,850
Local Protection Projects						
Levee Unit 3	90a	FC	2,030	280	2,310	
Levee Unit 9	90b	FC	520	80	600	2,910
Advanced Waste Treatment	—	WS	—	3,000	3,000	3,000
Water Supply	—	WS	—	8,000	8,000	8,000
EARLY ACTION AND LONG RANGE ENVIRONMENTAL REGIONAL AND SOCIAL MANAGEMENT AND OTHER MEASURES						
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Environmental Corridors	—	E,R,FW	1,296	1,296	2,595	2,592
Stream Fishery	—	E,R,FW	602	602	1,204	1,204
Access Sites	—	E,R,FW	37	37	74	74
Flood Plain Management	—	FC,E	150	—	150	150
Use of Surface Mined Areas for Recreation	—	E,R,FW	258	258	516	516
Land Treatment	—	E,SC	11,701	11,599	23,300	23,300
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Land Treatment	—	E,SC	4,572	4,531	9,103	9,103
Flood Plain Management	—	FC,E	353	—	353	353
Use of Surface Mined Areas for Recreation	—	E,R,FW	730	730	1,460	1,460
TOTALS 4/ - Federal First Cost			55,475			
Non-Federal First Cost				48,196		
Subbasin Grand Total					160,063	160,063

1/ Numbers refer to figure 115
2/ Purpose index - see table 66
3/ Authorized but not a part of Comprehensive Plan
4/ Subbasin Plan does not include basin wide measures

TABLE 90

LITTLE WABASH SUBBASIN DATA

General

Area (square miles)	3209
States (percent)	
Illinois	100
Indiana	0
Ohio	0
Physiographic areas (percent)	
Bloomington Ridged Plain	2.7
Springfield Plain	30.3
Mt. Vernon Hill County	67.0
Total	100.0

Population and Employment

	1960	2
Employment sectors (100)		
Agriculture	83	
Mining	33	
Construction	22	
Manufacturing	61	
Transportation	26	
Trade	78	
Finances	8	
Services	72	
Government	14	
Non-classified	8	
Population (100)	1193	2
Labor Force (100)	432	1
Employment (100)	405	

LOWER WABASH SUBBASIN

The Lower Wabash Subbasin drains the remainder of the Wabash Basin below the mouth of Patoka River, excluding the Little Wabash. Its 1,420 square mile drainage area qualifies it as the second smallest subbasin studied for this report. It is roughly trapezoidal in shape and extends about 70 miles from the headwaters of Bon Pas Creek to the mouth of Wabash River. It does not include the drainage areas of the England, Raccoon and Crawfish Creeks between Lawrenceville and Mt. Carmel, Illinois. The Bon Pas Creek in Illinois, which drains 280 square miles and Big Creek in Indiana, which drains approximately 250 square miles are the major tributary streams to the Wabash River in this area. A map of the subbasin is presented as figure 117.

Although the Lower Wabash Subbasin represents only 4% of the total Wabash Basin, all the excess water leaving the Wabash Basin above the mouth of Patoka River must travel through the broad, flat lowlands of the Lower Wabash. Consequently, annual flooding of these lowlands is a perennial problem. Width of the valley is four to six miles and the stream gradient is about one-half foot per mile.

Ground water availability ranges from 1000 GPM or more in the valley floor to as little as 20 GPM in the higher elevations of the subbasin.

Temperatures during July reach an average maximum of 90 degrees F. and drop to an average January minimum of 27 degrees F. Precipitation averages about 42 inches per year.

The major communities in this subbasin are Mt. Carmel, Illinois, on the northeastern divide, Crossville, Illinois, on the western divide and New Harmony, Indiana, near the center of the subbasin, and Grayville, Illinois. Their 1960 populations were 8,600, 875, 1,000 and 2,300 respectively. Population of the Lower Wabash was 333,000 in 1960 and is projected to reach 558,000 by 2020.

Grain farming is an important segment of the economy in the area, however, the trend in farm employment, as elsewhere in the Wabash Basin, is downward with considerable outmigration of displaced farm families. Employment in the trade, service and manufacturing industries is expected to increase but at a lower rate than for other subbasins.

The current plan of development for the Lower Wabash Subbasin includes several large levee units, one of which (Levee Unit 5) is completed. Four other agricultural levees are authorized in the subbasin, these being Units 1, 2, 3, 4 and Rochester and McCleary's Bluff Levee. Construction was started on the latter in July 1970. In addition to these projects, a local protection project is authorized for New Harmony, Indiana, and a bridge protection project has been completed at that location. A local protection project was completed at Mt. Carmel in 1968.

A channel improvement project was authorized in 1946 for the lower portion of Bonpas Creek in Wabash County, Illinois. As of December 1968, there were no Soil Conservation Service PL 566 projects authorized for construction in this subbasin; planning was essentially completed on the Gresham Creek Small Watershed Project, however.

The Comprehensive Plan for the Lower Wabash Subbasin, as developed for this report, places primary emphasis on small watershed projects to meet the increased demands in soil and water resources within the subbasin. There are five small watershed projects proposed for development under the early action phase of the Comprehensive Plan. They would control 228 square miles of drainage area and provide multipurpose storage totaling 74,800 acre-feet. About 621 square miles of agricultural land would be included in the total area of the projects. Also, a levee just north of New Harmony, Levee Unit 50, which would protect 3,000 acres of agricultural land, is recommended as a part of the early action program.

The long range plan includes two additional small watershed projects which would control 13 square miles and provide an additional 11,600 acre-feet of multipurpose storage.

General basinwide programs and proposals include features such as the environmental corridors, stream fishery preservation, municipal and industrial water supply and water quality measures, land treatment, flood plain management and public health considerations.

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WABASH RIVER BASIN COMPREHENSIVE STUDY. VOLUME I. MAIN REPORT.(U)
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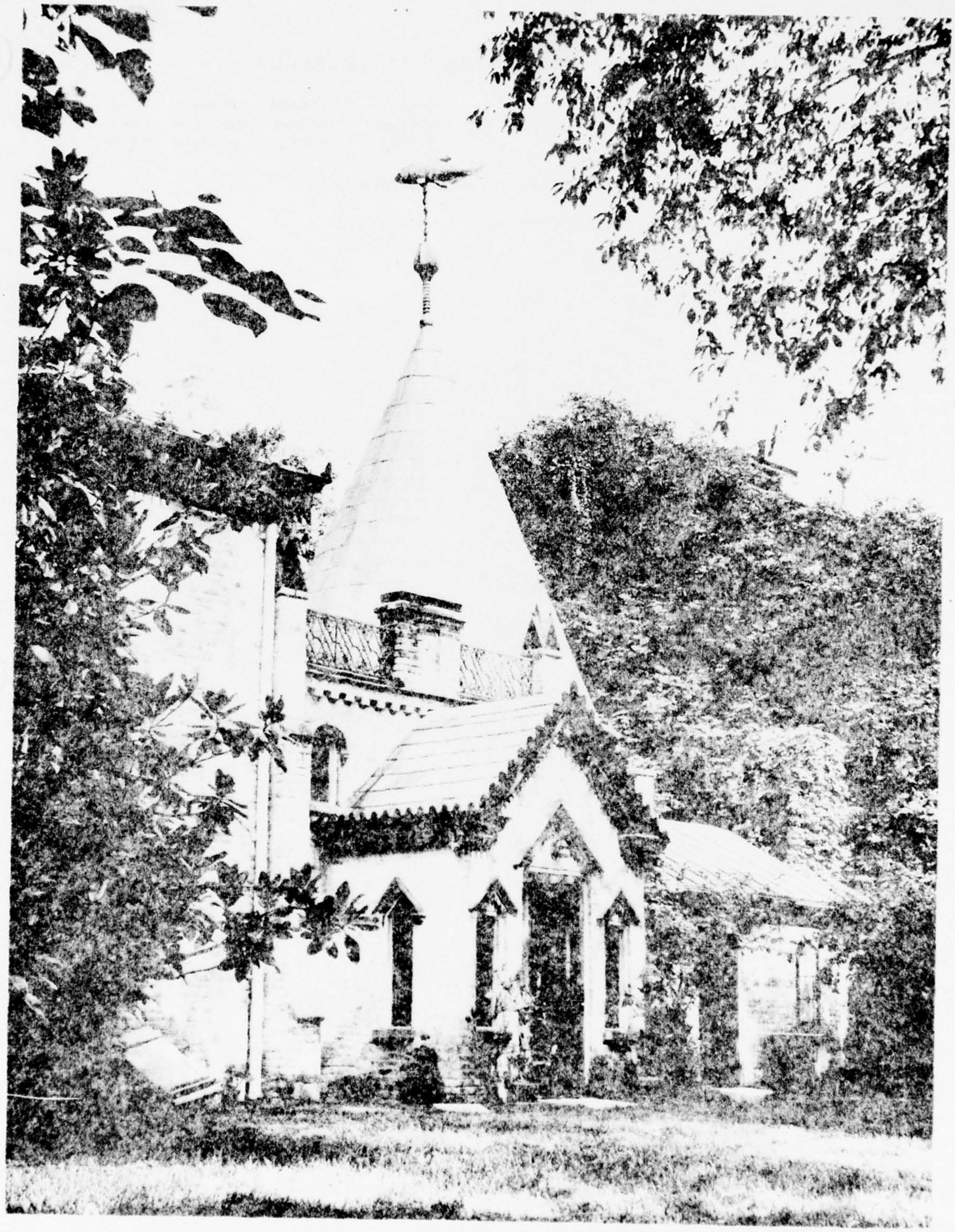


(Courtesy of Indiana Department of Natural Resources)
FIGURE 116. NEW HARMONY STATE MEMORIAL – LOWER WABASH SUBBASIN

TABLE 91

LOWER WABASH SUBBASIN – PLAN FEATURES AND FINANCIAL DATA

Project or Program	Subbasin Project No[1/]	Purpose [2/]	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
EARLY ACTION AND LONG RANGE STRUCTURAL MEASURES						
EXISTING, UNDER CONSTRUCTION AND AUTHORIZED						
Local Protection Projects						
Mt. Carmel (Ill)	2	FC			2,081	
Rochester-McCleary's Bluff (Ill)	4	FC			1,310	
Levee Unit 5 (Ind)	1	FC			5,471	
Bonpas Channel (Ill)	5	FC			1,263	
New Harmony[3/] (Ind)	3&6	FC				
Levee Units 3 and 4 (Ill)	7	FC			15,580	
Levee Unit 2 (Ind)	8	FC			2,119	
Levee Unit 1 (Ill)	9	FC			4,526	32,350
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Upstream Watershed Projects						
Big Creek (Ind)	11	FC,R,D	4,390	1,612	6,002	
Gresham Creek (Ind)	12	FC,R,D	1,362	883	2,245	
McHenry-Hawthorne (Ind)	13	N.A.	—	—	—	
Scott Ditch-Coffee Bayou (Ind)	13	FC,R,D	1,731	1,249	2,980	
Bonpas Creek (Ill)	14	FC,R,WQ,D,WS	5,147	2,595	7,742	18,969
Local Protection Projects						
Levee Unit 50 (Ind)	10	FC	545	62	607	607
Advanced Waste Treatment	—	WQ	—	—	—	—
Water Supply						
(Illinois)	—	WS	—	40	220	220
(Indiana)				180	220	220
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Upstream Watershed Projects						
Black River (Ind)	15	FC,R	1,320	514	1,834	
French Creek (Ill)	16	FC,R	830	555	1,385	3,219
Advanced Waste Treatment	—	WQ	—	—	—	—
Water Supply (Ind)	—	WS	—	1,000	1,000	1,000
EARLY ACTION AND LONG RANGE ENVIRONMENTAL, REGIONAL AND SOCIAL MANAGEMENT AND OTHER MEASURES						
RECOMMENDED FOR INCLUSION IN EARLY ACTION PLAN						
Environmental Corridors						
(Illinois)	—	E,R,FW	810	666		
(Indiana)				144	1,620	1,620

LOWER WABASH SUBBASIN PLAN

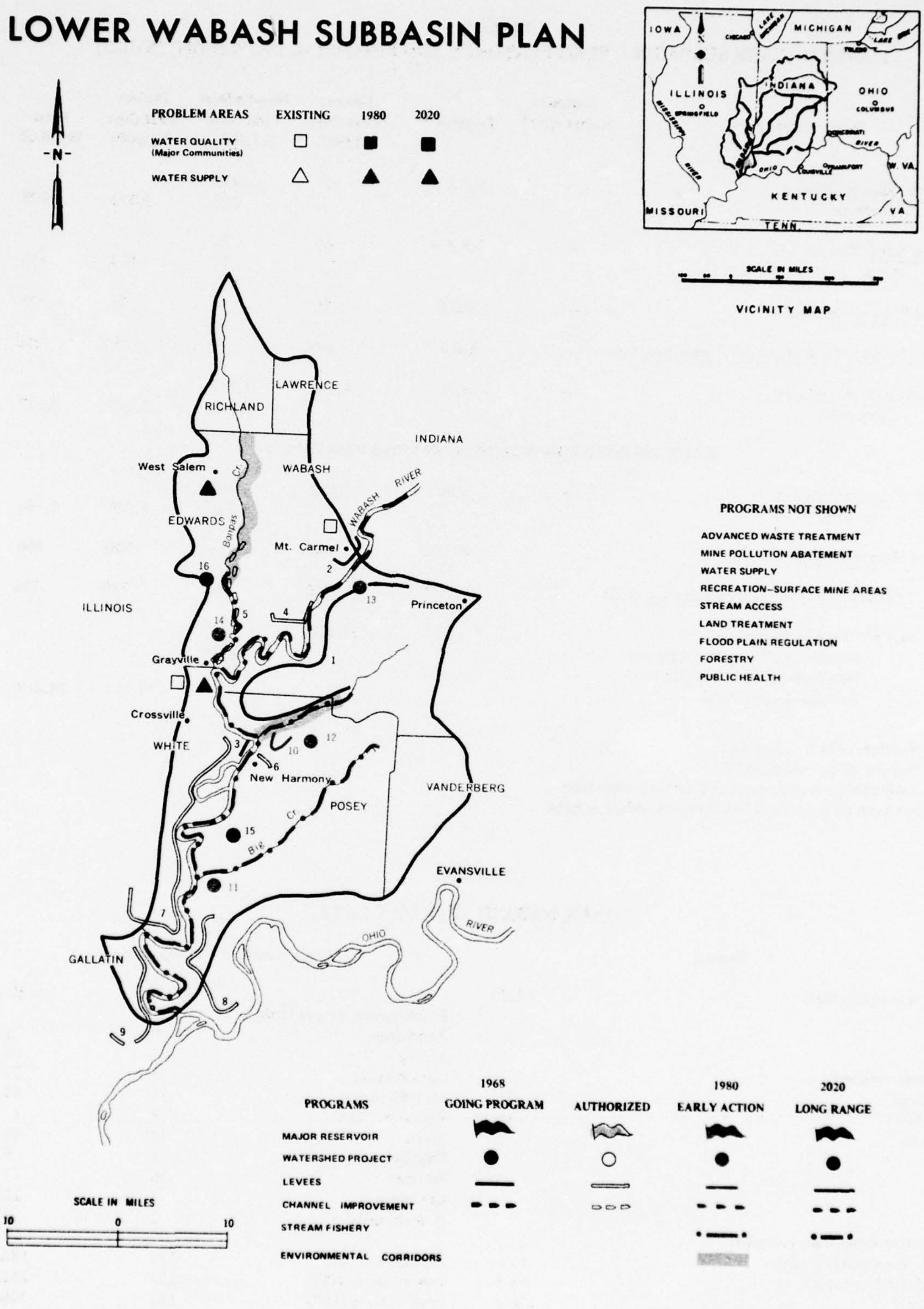


FIGURE 117

TABLE 91

LOWER WABASH SUBBASIN – PLAN FEATURES AND FINANCIAL DATA (CONTINUED)

Project or Program	Subbasin Project No.1/	Purpose 2/	Federal First Cost ($1,000)	Non-Federal First Cost ($1,000)	Project First Cost ($1,000)	Total ($1,000)
Stream Fishery (Illinois)	—	E,R,FW	514	249		
(Indiana)				265	1,028	1,028
Access Sites (Illinois)	—	E,R,FW	69	34		
(Indiana)				35	138	138
Flood Plain Management	—	FC,E	75	—	75	75
Use of Surface Mined Areas for Recreation (Ind)	—	E,R,FW	125	125	250	250
Land Treatment (Illinois)	—	E,SC	4,870	1,747		
(Indiana)				3,080	9,697	9,697
RECOMMENDED FOR INCLUSION IN LONG RANGE PLAN						
Land Treatment (Illinois)	—	E,SC	2,122	708		
(Indiana)				1,396	4,226	4,226
Flood Plain Management	—	FC,E	100	—	100	100
Use of Surface Mined Areas for Recreation (Ind)	—	E,R,FW	360	360	730	730
TOTALS 4/ - Federal First Cost			24,370			
Non-Federal First Cost (Illinois)				6,594		
Non-Federal First Cost (Indiana)				10,905		
Subbasin Grand Total					74,219	74,219

1/ Numbers refer to figure 117
2/ Purpose index - see table 66
3/ Authorized but not as part of Comprehensive Plan
4/ Subbasin plan does not include basin wide measures

TABLE 92

LOWER WABASH SUBBASIN DATA

General	
Area (square miles)	1420
States (percent)	
Illinois	57
Indiana	43
Ohio	0
Physiographic areas (percent)	
Mt. Vernon Hill Country	51.5
Wabash Lowlands	48.5
Total	100.0

Population and Employment	1960	2020
Employment sectors (100)		
Agriculture	19	6
Mining	7	4
Construction	7	39
Manufacturing	23	45
Transportation	9	11
Trade	22	44
Finances	3	8
Services	20	61
Government	3	15
Non-classified	2	2
Population (100)	333	588
Labor Force (100)	123	251
Employment (100)	115	236

SECTION VIII – SUMMARY EVALUATION OF THE COMPREHENSIVE BASIN PLAN

ECONOMIC SIGNIFICANCE

In the previous sections of this report the comprehensive plan is presented for the development and preservation of the land and water resources of the Wabash River basin. Any measure or evaluation of the plan should include a perspective of the merits of its features to accomplish the intended purpose and an indication of the affect on the local and national economy. In striving for the best results in both sectors, the Coordinating Committee used definite judgment and agency criteria in working out the proposed plan. This procedure is explained in the paragraphs which follow.

Within the framework of objectives previously related, the essential ingredients of all are to improve the totality of the environment for the people of the Wabash Region. The improvements proposed are not all measureable in tangible terms, however, where identifiable, benefits have been evaluated for the projects and programs in accordance with the previously indicated agency criteria. Essentially in developing the plan and in measuring the costs of the projects and the benefits thereof, the Coordinating Committee was well aware that some of its factors were based on judgment in lieu of any firm identifiable yardsticks or criteria. Estimates and projections of future population, agriculture and industrial water requirements and land resource demands were tempered with the realization that, while estimates cannot be exact and positive, the indication is very clear that a greatly increased demand for flood control, water supply, water quality control, and for the improved use, treatment, and productivity of land and environmental demands will occur.

The impact of the projects and management measures which involve increased production of commodities would be generally felt in the communities by requiring additional production materials and processing equipment as well as more services to provide the material, maintain the equipment, and to sustain its operation. These increased activities would stimulate a large exchange of money throughout the Wabash Region. Furthermore, it is expected that there would be sizeable impacts from general recreation and sport fishing and wildlife projects and programs. Fishing camps, motels, sporting goods stores, service stations, boat dealers, restaurants, and related new businesses would be required Figure 118 represents the total first cost of the plan – the monetary impact.

Development of the land and water resources plan for the Wabash Basin would unquestionably stimulate economic growth far beyond the basin limits. Some of the more significant impacts, for the purposes served by the comprehensive plan, are discussed below.

FLOOD CONTROL

Flood damage in the Wabash Basin has, in the past and currently, been quite serious with average annual flood damages exceeding $39.0 million in 1968. Damage has largely been confined to the

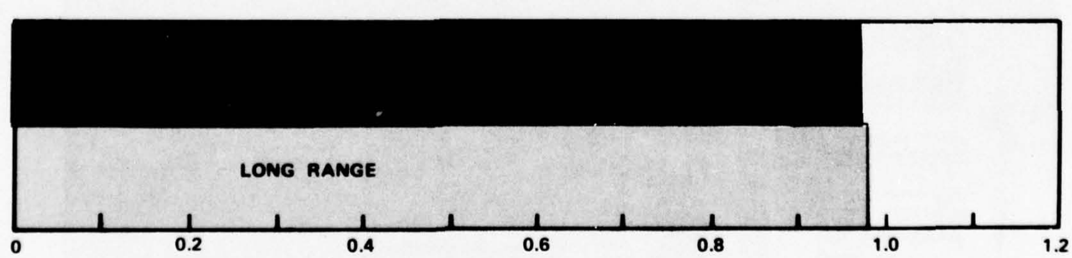


FIGURE 118

FIRST COSTS (BILLION DOLLARS)

FIGURE 119. THE CONQUEST OF YESTERYEAR – THE PLANS FOR TOMORROW

agricultural sector – crops and farm property. However, numerous urban areas have flood problems; the major urban damage centers are located at Indianapolis, Columbus, and Marion, Indiana. Without further project development or management measures, annual damages of $16.1 million in upstream areas are expected to increase to $37.2 million by 2020. In downstream areas average annual damages of $20.3 million have been projected to increase to $30.8 million by 2020 under the same assumptions. Many of the economic impacts from flood control measures will be reflected in improved land utilization for agriculture and other purposes. Lands in the flood plains are valuable for pasture land or cropland, but they are idle or in woodland use because of flood hazards. If the flood plains are better utilized because of flood control, marginal lands elsewhere could be used for such purposes as woodlands, hunting, and other recreational areas. Some of the lands to be protected are adjacent to the potential navigation route on the mainstem and could offer sites for industry. Thus, a successful flood control program may set in motion a change of land use shifts which could have far reaching consequences.

Generally speaking, there will be remaining damages because the effectiveness of the major reservoirs and upstream watershed structures decrease the further the area is downstream from the structures. Because flood damages are scattered all over the region, it is not economically feasible or practical to design structures or implement management measures to prevent all of the flood damages at any particular location.

The comprehensive flood control program is directed mainly toward the collective needs in areas where damageable values are of sufficient scope to justify the cost of projects and programs. Figure 120 indicates the effects of the proposed flood control program.

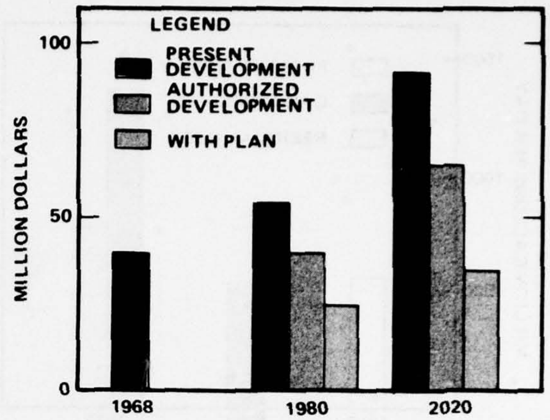


FIGURE 120

AVERAGE ANNUAL FLOOD DAMAGES

WATER SUPPLY

The comprehensive plan meets all of the identified municipal and industrial water supply needs in the basin during the projection period to 2020. All communities with a present need or foreseeable need were specifically analyzed. Satisfaction of the indicated and projected needs would be accomplished with proper utilization of surface water, ground water, return flows and pollution control measures.

Basically, future water requirements for municipal and industrial uses were projected to the year 2020 as presently indicated. Specific studies disclosed that the combination of sources within the basin, comprising existing and authorized storage facilities, six major reservoirs included in the early action segment; seven new reservoirs included in the long range segment; 22 additional upstream watershed reservoirs for watershed development which contain municipal and industrial water supply storage space; ground water; return flow; mainstem flow; and flow from areas not controlled by reservoirs, are sufficient to meet the needs and provide some basin surplus to 2020.

In this study, benefits from water supply were assumed to be equal to the cost of obtaining water of similar quantity and quality from the least cost and most likely alternative source. In this basin, Devonian and Silurian limestones, dolomites, and sandstones yield large quantities of water to wells in the northeastern part of the basin. Buried bedrock valleys and present river valleys contain thick deposits of glacial materials which are capable of supplying water to appropriately located municipal and industrial users.

The impact of making water generally available during the next fifty years is the greatest study contribution as water is the essential common denominator of all human activity. In realistic terms, the value of water to an area is many times greater than the cost of obtaining it. Study impact in numerical terms is illustrated in figure 121 for municipal and industrial supply.

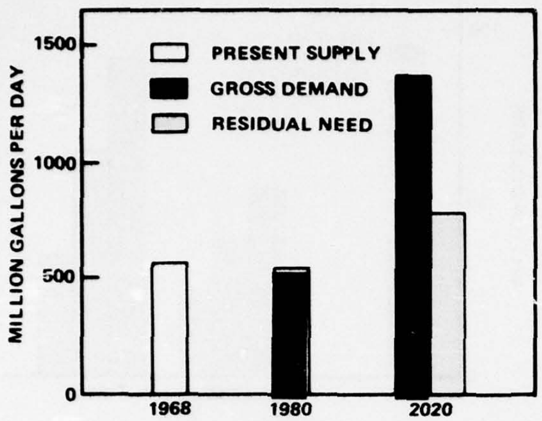


FIGURE 121

ADEQUACY OF M&I WATER SUPPLY

WATER QUALITY CONTROL AND PUBLIC HEALTH

Perhaps the most significant impact of the plan in this regard is the variety of measures for cleaning the basin streams – a clean stream enhances the well being of people and is a factor influencing their choices of residence, employment and recreation. The plan goes further to add measures to clean up aesthetic nuisances. These measures are extremely important in sustaining a healthy environment and in generally attracting others to the basin.

Advanced Waste Treatment and Low Flow Augmentation

Directly or indirectly, the water quality problems in the Wabash River basin stem from the population of 3,250,000 in 1960, which is projected to increase to more than 6,250,000 by 2020. By far the largest problem is probably the quantities and qualities of effluents discharged from municipalities and industries. In addition, the basin experiences a variety of problems from mineral production and agriculture.

The subbasin analyses presented in Appendix F – Water Use and Stream Quality considered alternatives at 81 municipal areas, some containing more than one community, which will need advanced waste treatment or low flow augmentation of sanitary and industrial waste waters during the projection period. The extra flow provided by reservoirs would allow less treatment or will provide high level treatment facilities to be installed at later dates thanotherwise would be needed. Special local pollution problems involving nutrients, color, industrial waste by- products, combined storm sanitary sewers, and thermal problems will have to be dealt with on an individual basis, and proper treatment at these locations should be provided. Special studies of these latter problems may be needed in the next few years as one or the other create particular problems.

Low Flow Augmentation

Five of the thirteen major multipurpose reservoirs and 22 upstream watershed reservoirs will provide for low flow augmentation at designated stream locations. This increase in flow will tend to enhance stream conditions for all water related activities. The improved water quality will enhance fishing potential and provide better water supply for wildlife, especially in streams that now experience no flow conditions during dry periods. One of the undetermined, but most important, values of low flow augmentation is that it affords a flexibility in the event of treatment failure or an inadvertant dumping of contaminents.

Coal Mine Drainage Pollution Abatement

Construction of two early action coal mine drainage pollution abatement projects will substantially minimize this problem in the basin. The two areas, the South Fork Patoka River and Busseron Creek watersheds, constitute the worst of the problem embracing about 6,000 acres. The impact of this program will make a major contribution to environmental quality. Related land treatment including grading, planting, seals and special treatments will help change the images of these problem points to the attractive areas that they indeed are.

AGRICULTURAL CONSERVATION AND MANAGEMENT

The land treatment measures include a large variety of practices such as terraces, drainage, waterways and small structures for watershed protection or water management that have a direct effect on land, water and other natural resources and needs.

Use and treatment of the Basin's land determines to a large extent the nature and seriousness of erosion and resulting sediment problems. Utilization of the land, consistent with its capabilities and limitations, and the application of conservation practices have a significant effect on reducing these problems. On treated areas, sheet erosion can be reduced as much as 90 percent by conventional conservation practices, such as contouring, terracing, and strip cropping. Treated forest land and land converted to forests are especially beneficial in reducing sheet erosion. The recommended early action land treatment program will treat 37 percent of the total basin area. Approximately 70 percent of the basin will be under treatment or have adequate treatment, if the early action program is accomplished. This would reduce erosion on treated areas to acceptable soil loss levels for protection of basic soil resource. This program would include land treatment acceleration in small watershed projects and behind major reservoirs; it would appreciably reduce excessive sedimentation in basin reservoirs.

Land treatment practices including improved cover conditions; water management; and management of farm waste, agricultural chemicals, and fertilizers would help to control possible undesirable environmental changes brought about by excesses. Since 88 percent of the Basin's agricultural area will be in production in 1980, the additional 57 percent of the basin expected to be under treatment in accordance with conservation plans will provide these areas with the most recent control and regulation methods to solve the more serious problems.

Critical sediment source areas that cause significant pollution problems in our streams, cause streams to fill with sediment and damage flood plain bottom lands can be controlled by land treatment. It is expected that by 1980, 216,000 acres of the basin will be converted to urban use. These and other construction areas are well suited for vegetative cover and other water and sediment control measures under land treatment programs. Stabilization measures for road banks, strip mines, construction sites, and other critical areas can reduce erosion and sediment production on these areas to minor amounts.

Cover condition improvements, conservation practices, and proper land use can reduce flood runoff from on-site areas as much as two to 25 percent. Conversion to forest land is especially

FIGURE 122. GRASSED WATERWAYS ARE AMONG THE MANY LAND TREATMENT PRACTICES NEEDED TO PROTECT THE BASIN'S CROPLAND

effective in reducing flood runoff amounts. The early action program will treat over 7,000,000 areas of agricultural land and 652,000 acres of forest land with conservation practices that are effective in reducing flood runoff.

The recommended forestry program for the Basin's forest lands, both public and private, will provide a substantial beneficial impact, both immediate and long range, and will increase at an accelerated rate over the projection period. Improvement in the hunting and fishing habitat in populations, water quality and health, vigor and volume of timber stands are but a few. The recommended early action forest land treatment program presented in Appendix H – Agriculture will provide 690 man-years of work associated with the installation of individual measures, reduce sediment movement, enhance the natural beauty and environment, improve fish and wildlife habitat and improve the raw material supply for wood product industries.

ENVIRONMENTAL RESOURCES

General

Of all the aspects of planning for water and related land resource development, the most difficult to approach are environmental resources. A large part of this difficulty stems from the fact that means for translating project induced environmental effects into quantitative terms are, for the most part, non-existent; therefore, the trade-offs necessary in formulating balanced solutions have to be made on the basis of judgments which are largely subjective. Thus, the impact of the comprehensive plan, insofar as the unmeasurable facets of the environment are concerned, can be discussed in only general terms.

As we may recall from our discussion of objectives, the primary objective of the Wabash Comprehensive Study has been to identify, evaluate and propose a water and land resource plan for meeting problems and needs as they arise based on economic and needs projections. Population growth and its urbanization effects will probably cause the greatest adverse effects on the environment. Based on the premise of substantial population growth, we cannot consider all resource development or even preservation development evil, as the pressures of the future mount and sociological order is to be maintained, timely development and preservation measures must be accomplished in the basin to meet the needs of water control, including quantity and quality; general recreation; and preservation of remaining areas of scientific, historic, archaeological and cultural significance. If all plans of this report fail, and this latter measure succeeds we will have passed a lasting legacy to future generations. The more significant environmental features and their impact is tablized, table 93.

Recreation

Recreation activities create economic stability in many areas of the basin, principally around the six major reservoirs. Several segments of the business sector such as bait stores and recreation and camping equipment outlets that are wholly dependent upon outdoor recreation pursuits have evidenced significant growth in the basin during the last decade. This trend is expected to continue as the comprehensive plan is developed and as leisure time and per capita income increase.

Outdoor recreation produces many primary benefits; some of these benefits are not of a purely economic nature; recreation provides a healthful exercise necessary for physical fitness. It promotes mental health and offers aesthetic values. It produces secondary benefits that are reflected in the economy of the area, the community and the Nation.

The anticipated needs for outdoor recreation opportunity are expected to increase from 38,000,000 recreation days in 1968 to 126,000,000 recreation days by the year 2020, or about three-fold. Needs in terms of resource requirements for developed land and water will increase from about 6,000 acres of land and 192,600 acres of water in 1968 to approximately 19,900 acres of land and 1,031,700 acres of water by the year 2020. Developed land acreages represent only that land required for development to meet the needs of specific recreation activities.

Additional land areas, in this report 90 percent is used, will be needed to provide the desired separation between activity and to provide open space. Under this premise total land needed amounts to about 60,000 acres in 1968 and will increase to about 198,000 acres by the year 2020. The project

TABLE 93

IMPACT OF ENVIRONMENTAL FEATURES

Feature	Impact
Environmental Corridors	Preservation of riverine areas for scenic preservation as well as for outdoor recreation use, including fishing, picnicking, hiking and wildlife study.
Fish and Wildlife	Enhancement of wildlife food and cover and fishing habitat. Improved management of fish and game with restocking of depleted areas and streams.
Stream Fishery Corridors	Designates stream fishing areas and provides for increased access to these areas, with parking and minimal services available.
Major Reservoirs	Provides major benefits for flood control, general recreation, water quality and water supply. Promotes conservation and additional uses of water – the most basic and the most important of our natural resources.
Upstream Watershed Projects	Provides major benefits for flood control, general recreation and water conservation. Also provides for land treatment measures, which preserve the steadily declining soil resources of the basin, which includes some of the richest, most productive land in America.
Wabash Scenic Parkway and Trail System	Provides transportation and a scenic walkway between northwestern Indiana and southeastern Illinois, along one of the most scenic and aesthetically pleasing routes in the basin.
Access Sites	Permits access to stream corridors and fisheries and provides parking, sanitation and minimal services.
Hoosier Lake National Recreation Area	This part of the plan would provide the south-central portion of the basin, which suffers a lagging economy, with base for generating economic growth through extensive tourist – recreational development in scenic knob country of southern Indiana. It would improve the quality of living for residents of the area and those who travel from afar to the lake and its environs.

supply, demand and resulting need are illustrated in figure 123. It may be noted that needs cannot be met with water and related land resources under present use arrangements.

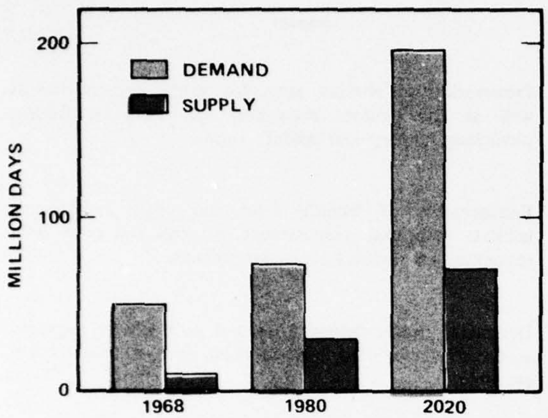


FIGURE 123

ADEQUACY OF PLAN FOR OUTDOOR RECREATION

Like the more tangible natural resources of the basin, recreational resources are widely scattered without relationship to human need, and there are few instances where recreation opportunities are available in satisfactory variety close to where the majority of the people live. While most industrial and community growth has taken place in the central and northern portion of the basin, almost all general recreation lands lie within areas south and west of Indianapolis, Indiana. In recognizing the inadequacies of present day and programmed recreation supply to meet current and projected demands, it is apparent that existing sources of outdoor recreation will have to be modified and new sources found or created. The need for recreation water and facilities will be most acute in urban areas where population increases have tended to concentrate and where the natural resources are least able to support the people.

Fish and Wildlife

The increased visitation by outdoor enthusiasts will increase pressure on the fish and wildlife regimen which even now suffers from the encroachment of urban areas. Implementation of the comprehensive plan would greatly increase the acreages of fishable water, but some losses of stream fisheries would occur. It is anticipated the plan would provide a fishery gain of 2,000,000 man-days, but generate a loss of 150,000 man-days for stream fishery in the study period. The plan would provide a gain in waterfowl hunting opportunities of 140,500 man-days and an overall gain in upland hunting although losses from impounded lands would occur. A summary of supply and demand projections is presented in figures 124 and 125.

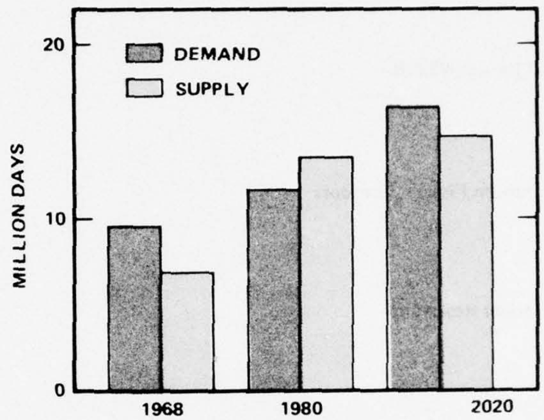


FIGURE 124

ADEQUACY OF PLAN FOR FISHING

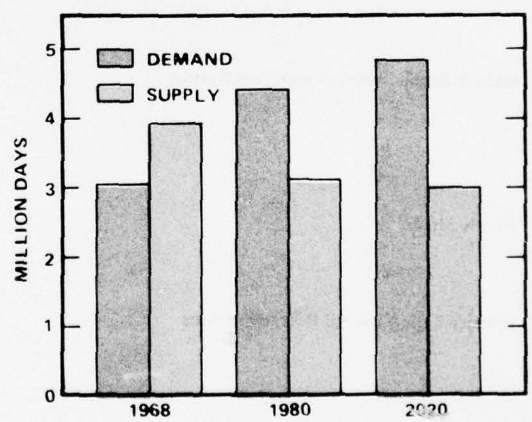


FIGURE 125

ADEQUACY OF PLAN FOR HUNTING

The expenditures of sportsmen in the project areas as well as in communities where they reside would add much to the basin economy. Additional employment would be afforded many small businesses including fish and hunting camps; and in

sales of food, gasoline, arms and ammunition, tackle, bait and other supplies. Benefits that are less tangible are derived from general enhancement of the recreational opportunities afforded to a given locality.

NAVIGATION

The studies for nine foot slack water navigation and a resulting project, if feasible, would satisfy current and projected bulk transportation needs in the basin. Through the potential project the basin would be afforded direct access by water to the Great Lakes on the north and to the deep water ports on the Gulf by way of the Tennessee River and potential Tombigbee River project, as well as the Ohio-Mississippi route. This potential would greatly enhance the area's ability to attract industry and traffic. The potential navigation routes are illustrated in figure 126.

The area on both sides of the river could benefit from navigation. Major exporting industries of the basin, particularly coal and grain, could utilize the river for shipping purposes. Mt. Carmel and Terre Haute would benefit by improving their position as trade centers for large portions of Illinois and Indiana. Industries that supply or consume large amounts of bulk commodities suitable for water transport generally find it advantageous and profitable to locate on navigable inland waterways.

In addition to the economic impact, there would be a widespread impact on the environment. Pending a determination of economic feasibility a detailed environmental study would be pursued to establish the best route with the least possible disturbance to natural features. With a full comprehensive environmental approach to a navigation route, it might furnish a lever for replenishing a naturalness to the valley which was virtually devastated in the settlement era.

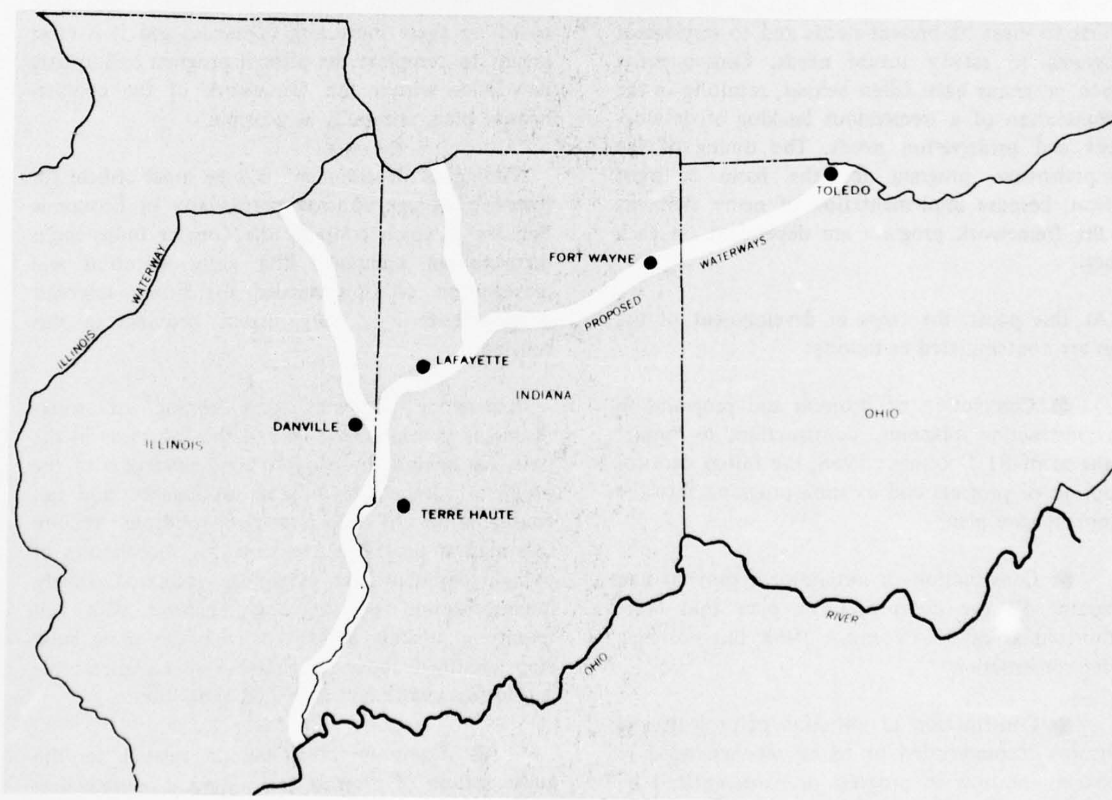


FIGURE 126
CROSS WABASH NAVIGATION PROJECT

SECTION IX – IMPLEMENTATION

GENERAL

The implementation of the comprehensive program to fulfill the near-term and future needs of the Wabash Basin requires immediate action to accelerate programs for water resources and related land resource development by over three-fold. Most of the early action programs are continuations of those currently underway. Although the basin has had a growth rate somewhat paralleling that of the nation, it has progressed rather slowly in response to the needs of the area. This slowness can be attributed largely to the sure complexity of the problems, the magnitudes of developments and preservation measures necessary, and the legal and insitutional problems which have retarded the area's ability to utilize its natural resources. To some degree, these problems have been partially dissolved in the process of instituting the existing and authorized water resource projects; other problems, such as funding, continue to harrass the basin's efforts to meet its present needs and to implement programs to satisfy future needs. Consequently, action programs have fallen behind, resulting in the accumulation of a tremendous backlog of development and preservation needs. The timing of the comprehensive program for the basin is most critical, because implementation of many elements in the framework program are dependent on each other.

At this point, the steps in development of the plan are contemplated as follows:

- Completion of projects and programs in pre-construction planning, construction, or similar status as of 31 December 1968; the initial date for adoption of projects and existing programs into the comprehensive plan.

- Construction or initiation of projects and programs in the comprehensive plan that were authorized as of 31 December 1968, but not then under construction.

- Construction or initiation of projects and programs recommended or to be recommended in investigations now in progress or contemplated by the early action plan to be required for meeting 1980 goals.

Orderly and timely completion of all the foregoing steps will require strengthening of the capabilities of the responsible water resource development agencies at all levels of government and private interests; it will require additional coordination between all interested parties.

TIMING

As is indicated in Appendix B - Economic Base Study, the Wabash River basin has the potential for continued economic growth. Population, economic activity, and personal income are expected to increase on the order of the projections outlined in Section III of that report. The rate of population growth will be somewhat less, but industrial output value in dollars will be essentially parallel to that of the nation. Urbanization is expected to continue at a rapid rate, increasing the emphasis on problems related to cities and their environs. Thus, it can be concluded that the timing of development should be based on these increasing demands, and it is most urgent to complete the present program and initiate new ones, within the framework of the comprehensive plan, as rapidly as possible.

Timing of development will be most critical for reservoir storage control, particularly in Economic Subarea 2, which contains the Greater Indianapolis metropolitan complex. The early selection and preservation of sites needed for future reservoir developments is a very urgent problem in this subarea.

Experience indicates that timing of water resources development will, in the future as in the past, lag behind the needs. Public awareness of the problems, desire for progress, willingness, and full consideration of all potential solutions require information programs and time for formulation of public sentiment. As previously indicated, timely implementation of the comprehensive plan will require immediate action involving the three basic steps outlined above. A fourth step completes the action framework and is related as follows:

- Continue investigations related to the authorization of projects and programs contained in the comprehensive plan and initiate new studies necessary to meet the objectives of the program for 1980 and beyond.

FINANCING

The Federal cost share of the projects and programs included in the comprehensive plan would be provided in accordance with legislation and regulations applicable at the time of funding. Non-Federal costs would be born by state and local governments and private interests. Funds for financing and appropriate reimbursement of the non-Federal share would come from sources such as outright grants from government and private funds, bonds, taxes received by government and development authorities and improvement districts, fees charged for project use, and revenues from the sale of resource projects such as water. Where financing is needed for projects, reimbursement to the Federal government would be made by non-Federal interests in the conventional manner.

Requirements for funding in the existing programs, without addition of new projects, would gradually build up and then decline until about 1980 when all elements would essentially be completed. As funding for completion of the growing program declined, actual expenditures to complete the early action portion of the comprehensive development program requirements will increase and surpass current expenditures. Estimates of the average annual construction cost of projects and programs on a unit cost basis for providing the initial facilities required to meet current and 1980 needs indicate that expenditures of more than twice that of the 1968 Fiscal Year expenditures are necessary to fulfill the comprehensive program goals. This is in addition to funds required for completion of the projects currently underway.

Table 94 is a summary of estimated initial construction costs required to provide for the units of water and related land resource development program needs by time periods. The estimates represent the accumulative and incremental cost for the designated dates in addition to the going program cost. Figure 127 is an illustration of first costs for the Wabash Basin development program.

INVESTMENT ANALYSIS

The following tabulation of table 95 summarizes, by time periods, the additional facilities and estimated initial facility construction and other costs on a unit investment basis for the comprehensive plan discussed in the preceding paragraphs.

The initial part of the summary presents the magnitude and estimated initial construction cost affiliated with the water resource developments

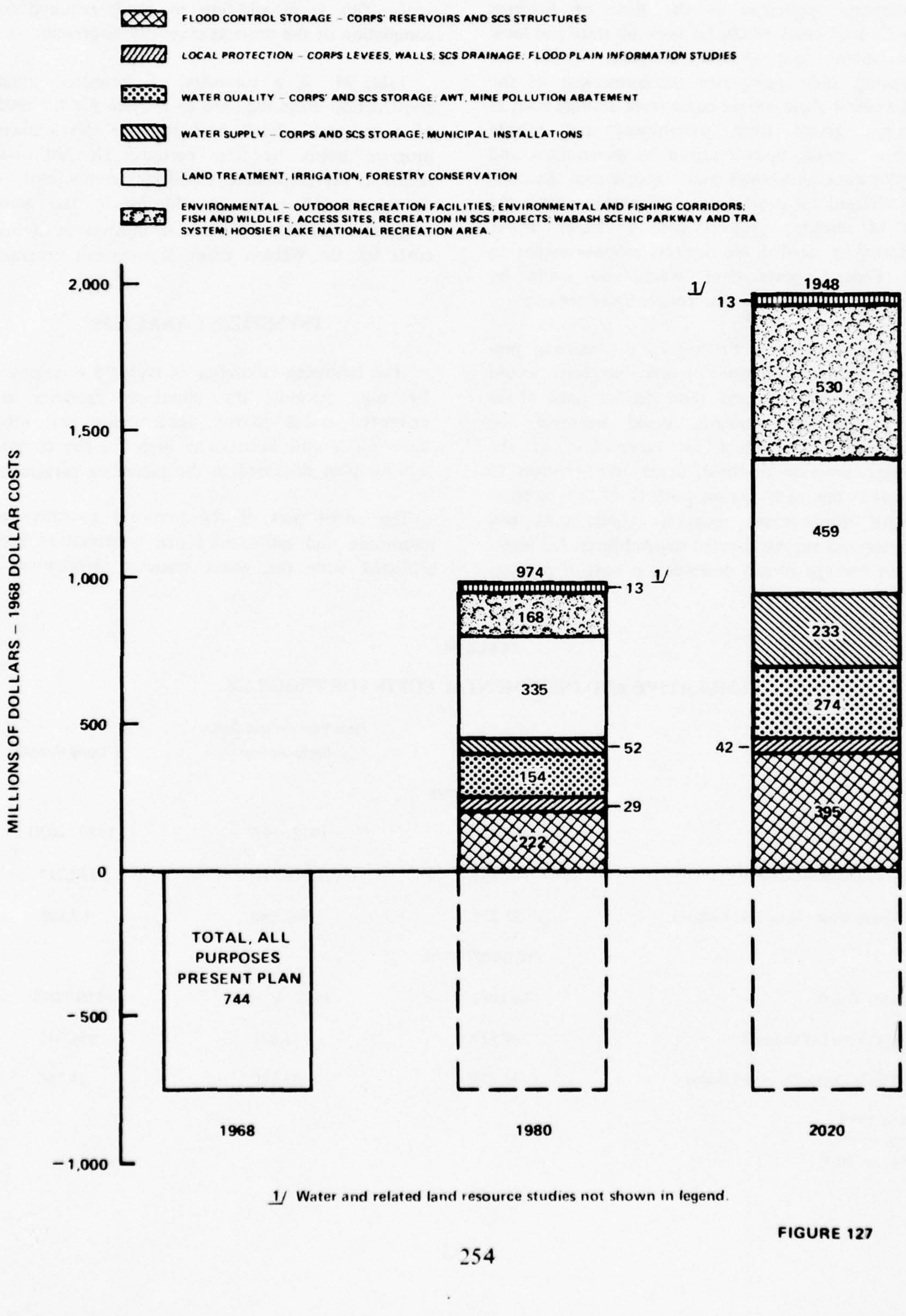
TABLE 94

CUMULATIVE AND INCREMENTAL COSTS FOR PROGRAM

Item	Present Plan 1/	Time Periods and Costs Early Action 2/	Long Range 3/
CUMULATIVE			
Time Period (Years)	To 1968	1968–1980	1980–2020
Total Cost (Thousand Dollars)	744,119	1,718,170	2,692,217
Average Yearly Cost (Thousand Dollars)	23,250	143,180	67,305
INCREMENTAL			
Time Period (Years)	To 1968	1968–1980	1980–2020
Total Cost (Thousand Dollars)	744,119	974,051	974,047
Average Yearly Cost (Thousand Dollars)	23,250	81,170	24,350

1/ 1936 to 1968.
2/ Needed by 1980
3/ Needed by 2020

CUMULATIVE FIRST COST OF COMPREHENSIVE PROGRAM (MILLIONS OF DOLLARS)



1/ Water and related land resource studies not shown in legend.

FIGURE 127

TABLE 95

WABASH RIVER BASIN PROGRAM SUMMARY

Project or Purpose		Quantities			Investment Costs ($1,000)		
		Early Action	Long Range	Total	Early Action	Long Range	Total
Flood Protection							
Major Reservoirs	Acre-feet	480,880	1,221,880	1,702,760	104,200	143,000	247,200
Local Protection	Acres protected	20,651	9,460	30,111	13,267	2,910	16,177
Upstream Watersheds	Acre-feet	659,000	209,690	868,690	118,098	29,987	148,085
SUBTOTAL					235,565	175,897	411,462
Water Quality							
Major Reservoirs	Acre-feet	253,000	—	253,000	64,800	—	64,800
Upstream Watersheds	Acre-feet	84,864	—	84,864	7,050	—	7,050
Advanced Waste Treatment	Number	112	64	177	72,470	120,000	192,470
Mine Pollution Abatement	Acres	6,000	31,000	37,000	10,000		10,000
SUBTOTAL					154,320	120,000	274,320
Water Supply							
Major Reservoirs	Acre-feet	111,760	—	111,760	25,500	—	25,500
Upstream Watersheds	Acre-feet	64,962	—	64,962	6,106	181	6,287
Municipal Installations	Number	69	190	259	20,600	181,000	201,600
SUBTOTAL					52,206	181,181	233,387
Irrigation	Acres	22,030	42,530	64,560	230	—	230
Drainage	Acres	206,800	85,800	292,600	14,027	6,985	21,012
Land Treatment	Acres	8,461,000	5,088,000	13,549,000	288,229	124,295	412,524
Flood Plain Management	Number	54	61	115	1,780	3,310	5,090

TABLE 95

WABASH RIVER BASIN PROGRAM SUMMARY (CONTINUED)

Project or Purpose		Quantities Early Action	Quantities Long Range	Quantities Total	Investment Costs ($1,000) Early Action	Investment Costs ($1,000) Long Range	Investment Costs ($1,000) Total
Forestry Conservation (Hoosier National Forest)	Acres	139,000	—	139,000	46,800	—	46,800
Environmental-Regional-Social							
Environmental Corridors	Miles	1,673	—	1,673	60,228	—	60,228
Fish and Wildlife	Man-days	3,732	—	—	3,044	1,590	4,634
Stream Fishery Corridors	Access Sites	1,604	500	3,759	19,400	3,000	22,400
Major Reservoirs	Man-days	13,757,000	14,400,000	28,157,000	21,820	70,420	92.240
Upstream Watersheds	Man-days	4,245,000	2,319,000	6,564,000	59,500	19,469	78,969
Wabash Scenic Parkway and Trail	Miles	—	212	212	—	150,000	150,000
Access Sites	Number	1,680	—	1,680	3,652	—	3,652
Hoosier Lake National Recreation Area	Man-days	—	10,000,000	10,000,000	—	117,900	117,900
SUBTOTAL					167,644	362,379	530,023
TOTAL, ALL PURPOSES					960,801	974,047	1,934,848
Studies							
Regional Centers, New Cities, Power					7,000		7,000
Grand Lake					250		250
Reservoir Regulation					1,500	—	1,500
Land Use					6,000	—	6,000
SUBTOTAL					13,250	—	13,250
TOTAL					974,051	974,047	1,948,098
Present Plan (Comprehensive Plan)							744,119
Present Plan (All Existing, Under Construction and Authorized, 1968)							(781,701)
TOTAL 1/							2,692,217

1/ Does not include portion of present plan (all existing, under construction and authorized, 1968)

required by the years 1980 and 2020. It includes the primary water resource development program needs for flood control, water supply and water quality control. Structural features of upstream watershed projects, lands for recreation, and other appurtenances to water resource development projects are included in the cost estimates.

The development program needs shown in the columns for 1980 and 2020 are the total additional that are required to be operational at those dates beyond the capabilities of facilities provided by the program existing in 1968. The nature and action sequence of developments and projects finally adopted will effect the timing of investment cost, especially for major multipurpose developments planned to fully develop site resources to serve needs for 50 years or more hence. It should also be recognized that major projects must be funded several years in advance of their required service date due to the time required for construction. Consequently, the initial development cost are only a general guide to budget or fiscal programming. All cost are based on a 1968 constant dollar value.

The related programs in the second part of the summary provide for the general recreation, sport fishing, and hunting opportunities made available by the water resource development projects and related lands. The costs are those for specific environmental facilities. Also included are all land treatment and management lands within the potential upstream watershed projects, above potential storage reservoirs, and critical areas, and other environmental features not previously included. In addition, it includes on farm improvements for irrigation and drainage. A considerable portion of these lands are within potential watershed projects. Detailed studies will be required to define all water resource development related items.

COST SHARING

Cost sharing indicates who will ultimately pay for a plan feature. Of course, Federal and non-Federal interests will be responsible, to varying degrees, for the financial obligations that are incurred by implementation of the comprehensive plan, as set forth in Section VII. The exact division between Federal and non-Federal costs will vary considerably, depending on the element of the plan that is to be implemented. Cost sharing is generally proportionate to the degree of interest each agency or other authority has in the project and also is dependent on the recipients of benefits from the projects. The Federal government has assumed some degree of responsibility in almost every phase of the water resources development in the Wabash River basin. Financial participation on the part of the Federal Government ranges from full Federal investment cost, which may or may not be reimburseable, to planning assistance and the granting of loans to State and local jurisdiction.

The cost of developing projects and programs that make up the early action and long range plan will be shared between Federal and non-Federal interest in accordance with legislation and regulations that are applicable at the time of financing. Non-Federal costs, as previously indicated, will be born by State and local governments and private interests and will be funded for such sources as outright governmental or private grants, revenue bonds, taxes, project use fees, revenue for very short product sales, and development authorities and improvement districts. A summary of non-Federal cost sharing policies for various elements of the comprehensive plan is contained in table 97, in addition to the legislative measures that established each policy. A general indication of cost sharing for the comprehensive plan in accordance with these present policies is given in table 96.

RESPONSIBILITY

Basically, the responsibility for initiating the plan must rest with the States and local interests. Even in the fields where a Federal agency is normally the organization which actually performs the detailed planning and construction, the impetus for the planning study must originate with those whom the programs and facilities will benefit.

For the Wabash Basin, the comprehensive plan is a combination of projects and programs formulated to meet the needs of the people for land and water resource development. In many cases, the comprehensive studies have not been carried beyond the reconnaissance level, and thus additional detailed planning is required prior to implementation of the plan. The present reporting authority does not provide that comprehensive plans include final project designs.

TABLE 96

COST SHARING POLICY

Element of Plan	Non-Federal Cost	Legislative Precedent
Flood Control		
Reservoirs	None	Flood Control Act of 1938.
Local Flood Protection	Furnish lands, rights of way and relocations Operate and maintain project Hold the Federal government free from damages	Flood Control Act of 1936, as amended.
Watershed Projects	Furnish lands, rights of way and relocations Operate and maintain project	PL 83-566, as amended.
Navigation		
Waterway Improvement	Various; present policy to provide dock facilities, some bridge and utilities relocations and lands and rights of way	Section I, River and Harbor Act of 1920.
Commercial Ports	Provide dock and associated facilities	Authorizing Legislation.
Hydropower Storage	Complete repayment of construction, operation and maintenance costs allocated to power	Flood Control Act of 1944.
General Recreation and Fish and Wildlife Enhancement	Fifty percent of separable costs Operate and maintain all facilities	Flood Control Act of 1944. Federal Water Project Recreation Act (PL 89-72).
Water Supply		
Municipal and Industrial	Complete repayment of allocated costs, with interest	Water Supply Act of 1958 (PL 85-500).
Irrigation	Repayment varies No interest charged System approximates 50 percent cost sharing	Reclamation laws and USDA policy for irrigation water.
Water Quality Control		
Flow Augment	None, when benefits are widespread	Water Pollution Control Act (PL 84-660), as amended.
Waste Treatment Facilities	Forty-five percent or more depending on construction grant.	Water Pollution Control Act (PL 84-660), as amended.

CONSTRAINTS

The current limitations of certain agency authorization and other legal arrangements may constrain the full implementation of the program in a timely manner. However, if consideration is given to the Agency Views' paragraphs in Section X, the more significant limitations can be remedied. The next several paragraphs will relate the more prominent of these. Various means of site preservation are needed for the projects and certain preservation features. It cannot be over-emphasized that actual development of the program of improvements will depend on the availability of the project areas for timely development and use. Because of generally uncontrolled land uses that prevail in the basin, there can be no assurance of site availability for reservoir purposes at anticipated future times of need unless positive steps are taken to preserve the areas for that specific use. From consideration of the factors involved it appears that the most practical means of preserving the reservoir sites would require: (a) that project sites be firmly fixed by detailed site investigations immediately following project authorization; (b) land acquisition programs, based on detailed site surveys, be initiated as soon as practical; and (c) leaseback and other programs to mitigate the effects of land acquisition be initiated.

There is a need for cost sharing for water quality control storage in upstream watershed projects. At the present time non-Federal interests are required to pay for the full cost of this storage; provisions for cost sharing for flow regulation under Public Law 566 would facilitate the construction of storage for this purpose. It would also make the cost sharing in this program consistent with that in other Federal programs.

A streamlining of legal arrangements is needed in most Federal projects. The administration costs in some instances deters potential local sponsors from proceeding with the various programs.

There are locations in the basin where flood control reservoirs cannot be justified using existing criteria, but, at the same time, there are needs for water supply, low flow augmentation and recreation. As alternative uses of water and needs expand, there will be a need for cost sharing or local support of single-purpose and multi-purpose developments without flood control.

Particular consideration is needed of all Federal agencies and local sponsors in relation to the quality of our environment –– the principle fishery streams, environmental stream corridors, natural areas, historical points and archeological sites.

The counties and states will need to be involved to properly consider enhancement or preservation of these sites.

COORDINATION IN KEEPING THE PLAN CURRENT

During the existence of the Wabash River Coordinating Committee, there was developed a very high degree of understanding and respect among the members of the Committee for the many related problems associated with water and land resources development and preservation. Each committee member ably presented the viewpoint of his agency or state, yet at the same time was cognizant of related effects on other agency and state views. The Coordinating Committee has been an effective organization for resolving these differences, not by ultimatum, but by objective analysis and deliberations on common problems in a attempt to reach a mutually satisfactory solution. In many instances, this required some compromise and subbordination of some views to come within a consensus of the group –– all within the basic common denominator or what is best for the overall plan in the study area.

There is a need to continue the planning and coordination that has been engendered by the Coordinating Committee so that the projects and programs recommended in the comprehensive plan can be implemented in the same atmosphere. There is also the need to provide a continuing basis by which the requirements for resources development can be compared with the actual accomplishments and the two maintained in satisfactory balance for the overall good of the people. In addition, it is expected that many new proposals for development and preservation measures, initiated by both public and private agencies, will need to be coordinated with those in the plan. Periodically, the comprehensive plan would be updated in the light of current requirements, and when necessary, revised to reflect changing conditions and technology. Since the Wabash River Coordinating Committee has served as the guiding organization throughout the Wabash River Basin Comprehensive Study, the Committee would appear to be the logical choice to carry on the coordination that has been established. A major point for continuing the Coordinating Committee is that interested Federal and state agencies are represented and channels of communication between the Committee and private and local interest have already been established; these would prove invaluable during the implementation process.

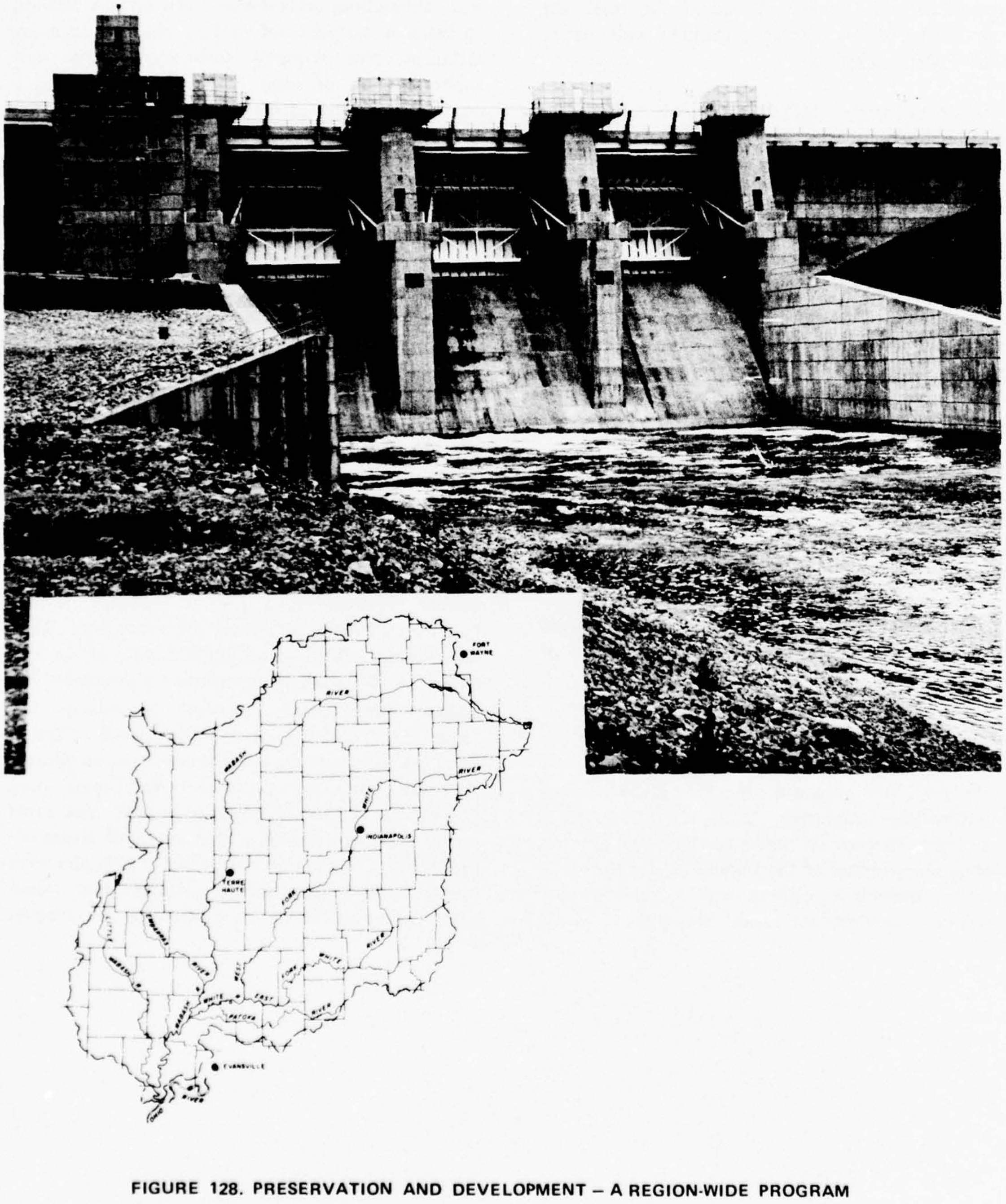


FIGURE 128. PRESERVATION AND DEVELOPMENT – A REGION-WIDE PROGRAM

SECTION X – DISCUSSION AND CONCLUSIONS

DISCUSSION

It is quite evident from the scope of this report that all of the Federal and State cooperating agencies, indeed all Americans, are concerned about the totality of the environment. Land and water resources development and preservation are important facets of the overall physical and economic progress required in a growing society. A successful plan for land and water resources depends largely on two determinations. One determination rests on studies and analyses by engineers, economists, environmentalists and other proposed professional planners of the physical practicability and economic feasibility of projects and programs, and the consequence of alternative decisions regarding resources development. The other is supported by political, financial and institutional constraints relative to project and program attractiveness and permissability from local, regional and rational standpoints. Both determinations are important – almost inseparable.

The Wabash River basin has the potential for continued population, employment and personal income growth through the study projection period. These sectors are projected at a slower rate of growth than the Nation, but average population densities are projected to increase decade by decade at a faster rate than for the Nation. The geometric proportion of people to land is greater in the study area at present and will continue to be. Currently the Indianapolis and Anderson-Muncie economic areas have per capita personal incomes averaging near or slightly above the national average; both Lafayette and Champaign-Terre Haute economic areas are presently below the national average per capita personal income. Realization of the projected levels of income depends upon a continuing rise in the productivity of the area workers as well as a large increase in employment. Urbanization, a trend well established, will be a major influence on future use of land and water resources. With this shift, which is part of a national trend, will came readjustments of political influences. There will be increased emphasis on the environment, industrial production and problems connected with urbanization; less emphasis on sustaining inefficient or uneconomic enterprises by means of institutional support. Thus, it is important that all understand that rising educational levels of the labor force and other adjustments are needed to promote increased productivity and to permit desirable shifts to projected employment levels.

It is unrealistic to expect or to seek immediate or formable changes which would severely disrupt the existing economy. It is likewise unrealistic for the Basin's people not to prepare to assume their most advantageous role in the rapidly evolving economy. Perhaps most important is that the people of the area appraise their overall opportunities and limitations, learned how their economic lot can be further proved, and seek the optimum use of their abundant resources. This should be started on a step by step basis to insure accomplishment of desired, long-range objectives. The comprehensive plan for the development and preservation of the area's land and water resource sector is presented in Section VII.

The plan recognizes the rights and major responsibilities of the Federal, state and local interests in the development of the land and water resources. It provides that the major portion of the new resource development programs and facilities be initiated, developed, and maintained on a partnership basis by the above interests.

The plan is designed to essentially meet projected needs through the year 2020 through efficient development and utilization of area resources. To be effective, the plan, as a joint local, state, and Federal effort, must be implemented in the form of actual programs and projects. In most instances, more detailed analyses and evaluations will be necessary before programs and projects are started. Because the plan is based on long-range assumptions and projects, it will need frequent reviews and periodic revisions to insure that it is properly responsive to changing times and conditions.

CONCLUSIONS

General Conclusions

Economic growth in the Wabash River basin will continue, although at a somewhat lesser rate than that anticipated for the Nation as a whole. Based on available projective series, the economic activities of the area as measured by productive output for the years 1980 and 2020 will be about 211 and 567%, respectively, of 1960 constant dollar levels, and population is expected to increase to an equivalent of 196% during that 60 year period.

The problems related to the basin's water and land resources that will have the most pronounced effects on the economy and welfare of the region are primarily associated with water quality; flood damages; water supplies for municipal, industrial, and agricultural purposes; land treatment and management; and environmental resources including water-oriented outdoor recreation and fish and wildlife recreation.

Major water and related land resources and problems are and will continue to be concentrated generally in areas related to intense economic activities and great population concentrations. Problems related to such urban areas as Champaign, Danville, Urbana, Rantoul, and Mattoon, Illinois, and Terre Haute, Muncie, Anderson, Kokomo, Lafayette, Marion, Bloomington, Logansport, Columbus, New Castle and Vincennes, Indiana, will worsen with the expected economic growth of the area in spite of the effectiveness of the current programs. Besides the major urban problems, there are many other significant problems and requirements, such as upstream flood control, irrigation and land drainage, enhancement of fish and wildlife habitat, erosion and sedimentation, and land treatment and management, present in or stemming from virtually every segment of the basin. Storage and flood detention structures on smaller streams to meet needs of subbasin areas are an essential part of the comprehensive plan to deal particularly with flood control, water supply, water quality control, and the environmental problems in the rural areas.

The principal problems common to most areas were considered in establishing the comprehensive plan for the basin, but there remains in many places significant problems of interest and concern to local governments and to private economic and social sectors in the basin. Because of the apparent interdependency of the welfare of the various portions of the basin in the relation of the basin's economy to that of the Nation as a whole, the basic requirements for water and related land resources are generally adequate if properly developed, used, preserved and managed, to cope with the requirements of the area as foreseen in this investigation. However, in many cases, the resources are not available at the place and time to cope most effectively with the requirements and problems. Continued and careful development program planning to take care of such conditions will become increasingly important as the requirements increase and the available unused resources decrease.

The future well-being of the people, economic growth, and the environmental quality of the Wabash River basin depends in a large measure on timely implementation of the coordinated, basin-wide comprehensive program as outlined for utilization, conservation, preservation, and management of its available water and related land resources.

The Wabash River basin contains areas ranging from those with lagging economic growth particularly in the southern subareas to areas of relative affluence such as Economic Subarea 2 which includes Indianapolis. Water and related land resource development programs with flexible management are required in all portions of the region and must be responsive to local, regional, and National goals and objectives. The programs and projects must provide for all foreseeable purposes whenever feasible and be compatible additions to a broad system of development projects to meet basinwide problems as well as specific functional requirements and local needs. This will require an effective overview of water and related land resource development and use on state and basinwide basis to insure continued and balanced economic growth and social betterment in all portions of the Wabash River basin.

Agency and Work Group Views

Agency and work group views are reflected in the 13 appendices to this report. Individually, they may not represent the views of the Coordinating Committee which has concluded the study considering all study input in forming the recommendations of Section XI.

SECTION XI – RECOMMENDATIONS

The Wabash River Coordinating Committee recommends that:

TO ESTABLISH THE PLAN

1. The Comprehensive Plan, described in Section VII of this report, be adopted as the basic plan for the conservation, use, development and proper preservation of the Wabash River basin.

2. The Early Action segment of the Plan, which includes projects and programs needed now or by 1980, be implemented through the appropriate agencies.

3. Those additional projects and programs in the Long Range segment of the Plan be given further consideration at such time as the social, regional, environmental or economic conditions warrant.

PHILOSOPHICAL

General

4. That the sound development and management of the Basin's water and related land resources is vital to sustaining a desirable posture of health, welfare and economic stability of the basin.

5. That other existing programs that contribute to improvement of the health and welfare of the Basin's present and future populace be continued and increased where appropriate.

6. That other new programs that would contribute to an improved quality of living in the basin be developed and implemented.

7. Plan elements should be integrated for development and management in accord with their information, as a subbasin system.

Specific

8. Water Quality – That regionalized management be encouraged in developing solutions to water quality problems of more than local scope, without closing off options for individual initiative and ingenuity.

9. Ground Water Use – That due to inherent advantages with regard to treatment and easy availability, ground water be utilized for water supply to the capability of the aquifer, without, however, exceeding the average recharge rate, and that present ground water studies be expanded to locate and determine the potential of aquifers in the basin.

10. Water Reuse Systems – The research and demonstration of efficient, safe and workable water reuse systems after advanced waste treatment in the interest of optimum use of the Basin's water resources and in the interest of minimizing adverse effects on the environment be pursued.

11. Water Quality Monitoring Systems – The present water quality monitoring systems of the Wabash River basin be studied with the aim of expanded coverage including but not limited to 1) additional stations, especially downstream from major wastewater discharges; 2) a more extensive pesticide monitoring program; 3) systematic and extensive monitoring for heavy metals; 4) additional time of travel studies; 5) stream flows wherever needed; 6) continuous temperatures monitoring at selected stations; 7) nutrient content and related studies in larger reservoirs; and 8) study of brine concentrations in potable aquifers in oil field areas.

POLICY – LEGISLATIVE

12. That the Wabash River Coordinating Committee be continued on an "on call" basis until the Chairman is advised by the Chairman of the Ohio River Basin Commission that the continuation of the Coordinating Committee is no longer required.

13. That the needed legislative modification as enumerated in table 97 pursued with maximum vigor.

IMPLEMENTATION

To Implement

14. That the Comprehensive Plan, described in Section VII of this report and the following recommendations be implemented.

15. That the plan be implemented as early as financially practicable in accord with the time frames indicated.

16. That timely authorization be obtained where necessary by each agency to implement elements of each of the subbasin plans.

17. It is recommended that special authorization be provided to place priority emphasis upon early implementation of conservation land treatment and management practices above all major reservoirs in the basin as outlined in the comprehensive plan and similar to that carried out in small watershed projects.

18. Provide special authorization for approximately thirty small watersheds identified in Section XIV which are closely interrelated with other developments in the early action plan of Appendix H – Agriculture. Because of these interrelationships concurrent or timely planning and installation of the related projects is essential to provide the most effective and efficient combination of measures.

19. That the plan elements be subject to modification as necessary and desirable – as more detailed studies progress, in the interest of improved efficiency, increased environmental consideration, the evolving regional requirements and the well being of the populace – all within the framework and thrust of the plan as presented.

20. That a systematic approach and immediate action be taken to solve water quality problems caused by combined storm-sanitary or sewers, applying sound engineering principles to solve each problem on a case-by-case basis to achieve the most benefit for the least cost, taking into consideration results from present and future research projects as new approaches become available.

21. That the plan be reviewed and updated periodically to assure that it continues to meet the Basin's needs as the projected needs are transformed into real needs.

22. The Committee recognizes that channel alterations may be detrimental to environmental values, but the Committee is not convinced that channel alterations must necessarily be detrimental. There is present technology and technique for channel alterations which can minimize this damage or even improve natural channel conditions. The Committee concludes that each channel alteration be examined in the light of a multiple objective approach within the purview of the National Environmental Policy Act of 1969 (Public Law 91-190) and in conconance with the Fish and Wildlife Coordination Act. Pending this examination such channel alterations should be in accordance with the best practical technology available.

To Support

23. Development of a Comprehensive Water Regulation Plan with an environmental approach commensurate with the natural ecosystems of the basin.

24. A Comprehensive Environmental Open Space-Land Use Study be initiated, in which particular emphasis be given detailed planning for the environmental corridor and stream fishery systems commensurate with public visitation and wildlife habitat needs and features identified in the environmental inventory be further explored for proper public use or preservation objectives.

TABLE 97

LEGISLATIVE MEASURES

Area of Concern	Measure
Water Quality	That the adoption and especially the enforcement of sewer use ordinances become widespread in the basin. These sewer use ordinances should include regulations that control or prohibit type of waste introduced that may be injurious to the sewer or disrupting to the treatment process and system of surcharges that provides equitable proportionate payment of cost.
	That nutrients from municipal or industrial sources be prevented from entering streams where practicable by:
	Prohibition of phosphorus-bearing detergents, as sufficient quantities of safe and efficient phosphorus-free detergents become available, and/or making phosphorus removal part of the advanced waste treatment process where needed, as shown in the water quality control plan, and
	Making nitrogen removal part of the advanced waste treatment process especially those communities located upstream from a present or proposed reservoir, as shown in the water quality control plan outlined in the subbasin sections.
	Public Law 566 under which a number of the structural components of the plan would be constructed does not provide for any Federal participation for storage for water quality control. It would appear only equitable and fair that the criteria for including water quality control in small projects would be the same as if a large project were built and that Federal interests would be the same in both cases. In other words, where the beneficiaries are widespread and augmentation of low stream flow is not provided in lieu of adequate treatment at the source that there should be a uniform Federal responsibility in financing the cost for storage for water quality control.
Environmental Corridors	There is existing legislation which provides general authority for undertaking the development of an environmental corridor system as recommended in the plan. The Wild and Scenic Rivers Act has not considered any streams in the Wabash Basin. Irrespective of that we believe and conclude that although none of the environmental corridors, in isolation, have national significance, the system as included in the plan has a significant national objective. Accordingly, we believe that the funding for the environmental corridors whould be cost shared between the Federal government and non-Federal interests in a 50-50 basis. In other words following the intent of Public Law 89-72, the Federal Water Project Recreation Act and Public Law 566, which enable the Federal government to cost share with non-Federal interests on an equal basis. We could not determine that there was any equitable difference between the traditionally accepted specific water using recreation activity and the more pastoral type recreation activity which would be provided by and environmental corridor system. Accordingly, it is felt that equity could best be served if there was a 50-50 cost sharing on the environmental corridors.
Other Environmental	The basin states be encouraged to develop guidelines and the local governments adopt and implement zoning standards and building and sanitary codes designed to protect and enhance the public investment and the recreational, fish and wildlife, and environmental values inherent in natural and impounded waters.

TABLE 97

LEGISLATIVE MEASURES (CONT'D)

Area of Concern	Measure
Recreation	In trying to develop a basin plan for water resource development, we find that Public Law 89-72, the Federal Water Projects Recreation Act adds considerable difficulty to developing efficient plans. This difficulty results from the language in 89-72 which pertains to the level of recreation benefits that are inherent in any particular project. P.L. 89-72 concludes that nor more than 50 percent of the cost can be allocated to recreation in any project. In developing basin plans we are concerned with overall efficiency, the overall basin objectives, rather than the specific efficiency of a project and the special objectives of a project. In many cases we find that the best balanced basin plan is made up of imbalanced projects. Accordingly, although the basin plan should meet the requirements of Public Law 89-72, it may be that specific projects would not meet that requirement. We believe that Public Law 89-72 should be revised to reflect that when a project is part of a comprehensive basin plan that it would not have to meet the 50 percent rule if in fact that project was unbalanced in order to provide the most efficient plan. Public Law 89-72 should also be revised to provide for continuing developments at authorized or completed projects.
Ground Water	We believe that there needs to be greater identification by virtue of research and study on the quantity and quality of ground water. In all of our deliberations we find that the greatest unknown regarding the specific quantity and quality of the resource lay in the area of ground water.
Flood Plain Management	The States and subdivisions thereof are strongly encouraged, as a matter of urgency, to develop and implement sound flood plain management practice to prevent nonconforming developments in the flood plain. To this end, Federal construction funds would not be expended for future authorized projects unless and until the States certify that the appropriate areas receiving primary flood control benefits have effected flood plain management practices, acceptable to the State, which could include zoning.
Site Preservation	That compatible Federal and State legislative authority be obtained to acquire, protect and preserve the water storage sites where such sites are required for the long term welfare of the populace and that interim uses be made of these sites for recreation, fish and game management, agricultural production and forest management in accord with land use plans to be prepared by Federal and non-Federal interests.
Water Supply Storage	That Title III of Public Law 85-500 (and comparable portion of Public Law 566) be modified to enable the Federal Government to underwrite the initial cost of providing added storage in projects for municipal and industrial water supply purposes. Provided there is a reasonable expectation that such storage will be required during the functional life of the project; and provided further, that non-Federal interests indicate their intent to utilize this storage at the time of need with payment and interest to begin at the time of use.

WABASH RIVER BASIN

COMPREHENSIVE STUDY

MAIN REPORT

ATTACHMENT A

PROJECT DATA
AND
WATER QUALITY CRITERIA

WABASH RIVER COORDINATING COMMITTEE

ATTACHMENT A

PROJECT DATA AND WATER QUALITY CRITERIA

TABLE OF CONTENTS

ATTACHMENT A

PROJECT DATA AND WATER QUALITY CRITERIA

INTRODUCTION

Attachment A of the Main Report, Wabash River Basin Comprehensive Study, is made up of pertinent data for projects included in the Early Action and Long Range Plans. Pages A–2 through A–27 contain maps and data sheets for the thirteen Corps of Engineers' projects in the above mentioned plans; tables A–1 through A–5 include physical and cost data for the Department of Agriculture, Soil Conservation Service's upstream watershed projects in the same plans.

The remainder of this attachment is comprised of water quality criteria for the three basin states – Ohio, Indiana and Illinois. More detailed data for water quality criteria are contained in Appendix F – Water Use and Stream Quality.

AZALIA RESERVOIR

FIGURE A-1

AZALIA RESERVOIR

Location

Azalia Reservoir would be located on Sand Creek, a tributary of East Fork White River, in Bartholemew, Jackson, and Jennings Counties, Indiana. The damsite is about 2.5 miles southeast of the town of Azalia, Indiana. The project would control 250 square miles or 97 percent of the total 259 square mile drainage basin of Sand Creek.

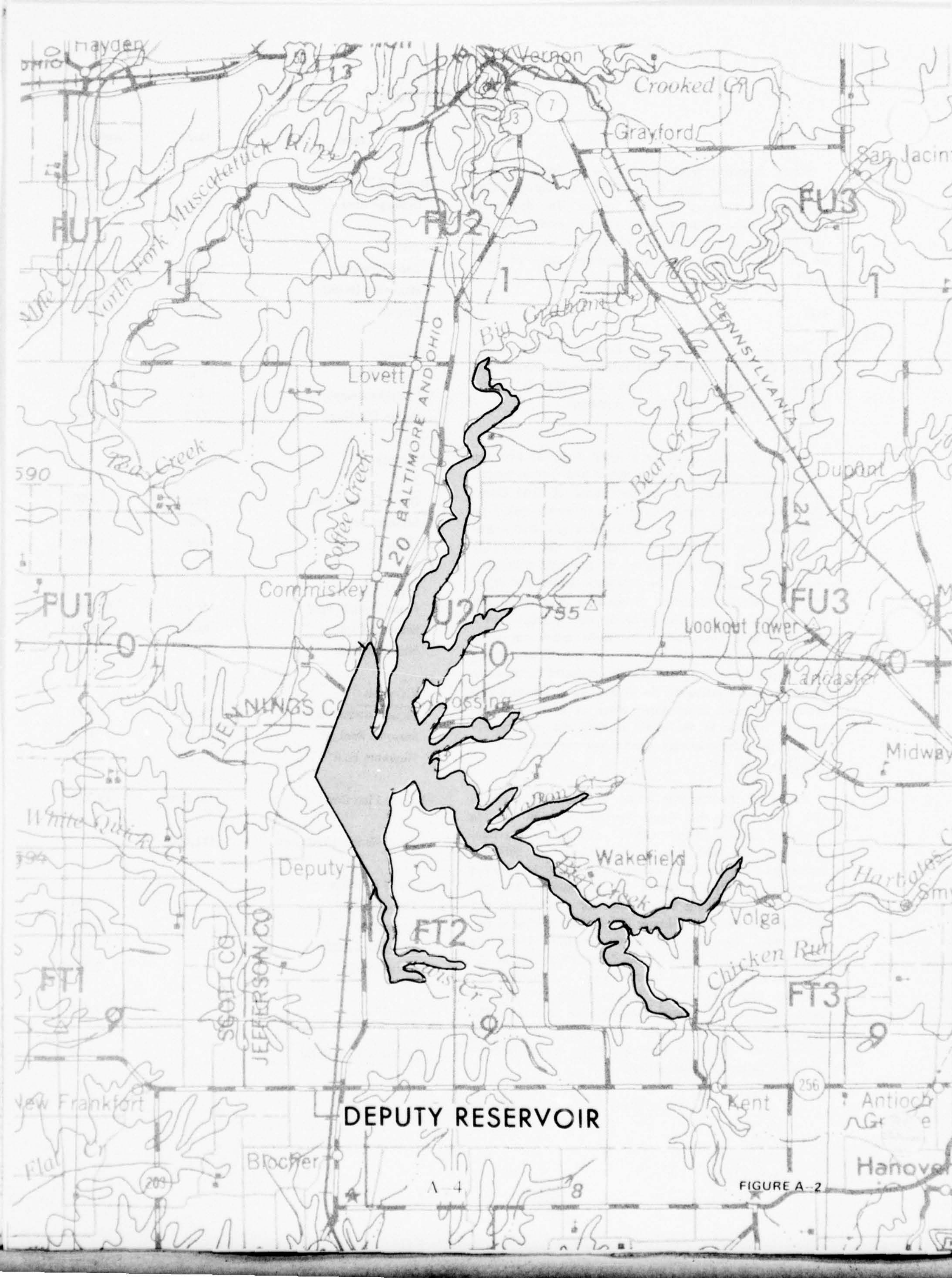
Plan

As presently planned, Azalia Reservoir would provide storage for flood control and recreational purposes and would have additional storage capability if future conditions indicate a need for such storage.

The Azalia dam would be a rolled earth fill structure with a gated concrete spillway about 375 feet in length, located in the valley on the right bank of Sand Creek. The dam would be about 30,000 feet in length with 1 on 3 side slopes, a 30 foot top width and a maximum height of 60 feet. Foundation conditions are generally satisfactory for dam and reservoir development although a triple grout curtain will be necessary across the valley floor to prevent formation of solution channels in this underlying limestone. The reservoir site is located in a geological area characterized by slight relief and wide, poorly drained flood plains. The major tributaries entering the proposed reservoir are heavily dissected with dense wooded slopes reaching to the upland areas. The proposed reservoir averages about three miles in width near the damsite, whereas in the upper reaches, the pool rapidly retreats into the relatively narrow entrenchments of the parent stream.

Lands for the reservoir would be acquired to a level five feet above the flood control pool to provide freeboard against adverse effects such as wave action, saturation, and bank erosion. A minimum of 300 feet horizontal from the flood control pool would be required where the five-foot freeboard fails to provide this area. Additional land would be acquired for access areas and other public use. The reservoir area would be cleared two feet above the seasonal pool elevation. There are approximately 2.7 miles of improved roads within the reservoir area that would require raising or relocation. In addition, one cemetery and approximately 18 miles of utility lines would require relocation or alteration. The project would include boat launching ramps, parking areas, general recreation sites, and other related facilities necessary to assure public access.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	250
Dam		
Top Elevation	Ft, msl	635
Maximum Height	Ft	60
Length	Ft	13,500
Spillway		
Top of Gates	Ft, msl	627
Effective Length	Ft	420
Design Discharge	CFS	165,600
Reservoir		
Area		
Flood Control Pool	Acre	4,500
Seasonal Pool	Acre	3,000
Minimum Pool	Acre	1,700
Capacity		
Flood Control Pool	Ac-Ft	66,600
Seasonal Pool	Ac-Ft	26,600
Minimum Pool	Ac-Ft	13,320
Elevation		
Flood Control Pool	Ft, msl	627
Seasonal Pool	Ft, msl	616
Minimum Pool	Ft, msl	605
Project First Cost	($1,000)	29,300
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		654
Recreation		1,620
Fish and Wildlife		50
Total Benefits		2,324
Annual Costs		1,790
Benefit to Cost Ratio		1.30



DEPUTY RESERVOIR

FIGURE A-2

DEPUTY RESERVOIR

Location

Deputy Reservoir would be located on East Fork Muscatatuck River, a tributary to East Fork White River in Jefferson and Jennings Counties, Indiana. The damsite is about one mile north of the town of Deputy, Indiana and approximately 0.8 mile downstream from the junction of Graham Creek and Big Creek. The project would control 294 square miles or 26 percent of the total 1,140 square mile drainage basin of the Muscatatuck River.

Plan

Deputy Reservoir would provide storage for flood control, low flow augmentation and general recreation and fish and wildlife recreation and enhancement. The selected plan consists of an earthfill dam with an open cut spillway. An 8.5 foot diameter concrete conduit would discharge up to 3,500 cfs for normal flood control operation and multistage outlets would furnish reoxygenated water for low flow augmentation. The dam would be about 12,000 feet long at crest elevation 657 with a maximum height of about 100 feet. Preliminary site investigations of geological conditions at the site indicate that extensive grouting would be required to prevent solutioning through the soluble limestone underlying the thin Illinoian drift. About four miles of improved roads in the reservoir area would require relocation or alteration and about two miles of railroad track that cross the reservoir area would be raised above the flood control pool. About 20 miles of utility lines would require relocation and four cemeteries would be moved to higher ground.

Lands for the reservoir would be acquired to a level five feet above the flood control pool to provide freeboard against adverse effects such as wave action, saturation and bank erosion. A minimum of 300 feet horizontal from the flood control pool would be required where the five foot freeboard fails to provide this area. The reservoir area would be cleared to two feet above seasonal pool elevation. Recreation facilities would be provided for boating, swimming, camping, picnicking and sightseeing, and would handle 900,000 user-days annually. The flood plains are narrow and moderately wooded, while the upland fringe areas of the pool contain scattered stretches of forested area with deeply dissected channels. The rugged scenic beauty of the upland areas would offer many attractive sites for water related recreation activities.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	294
Dam		
Top Elevation	Ft	651
Maximum Height	Ft	101
Length	Ft	12,000
Spillway		
Crest Elevation	Ft	636
Effective Length	Ft	800
Design Discharge	CFS	142,000
Reservoir		
Area		
Flood Control Pool	Acre	4,320
Seasonal Pool	Acre	3,000
Conservation Pool	Acre	2,100
Minimum Pool	Acre	1,100
Capacity		
Flood Control Pool	Ac-Ft	103,000
Seasonal Pool	Ac-Ft	30,800
Conservation Pool	Ac-Ft	28,000
Minimum Pool	Ac-Ft	16,000
Elevation		
Flood Control Pool	Ft	636
Seasonal Pool	Ft	618
Conservation Pool	Ft	606
Minimum Pool	Ft	588
Project First Cost	($1,000)	29,600
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		1,224
General Recreation		522
Fish and Wildlife		30
Water Quality and Water Supply		523
Total Benefits		2,299
Annual Costs		1,805
Benefit to Cost Ratio		1.27

PARKER RESERVOIR

FIGURE A-3

PARKER RESERVOIR

Location

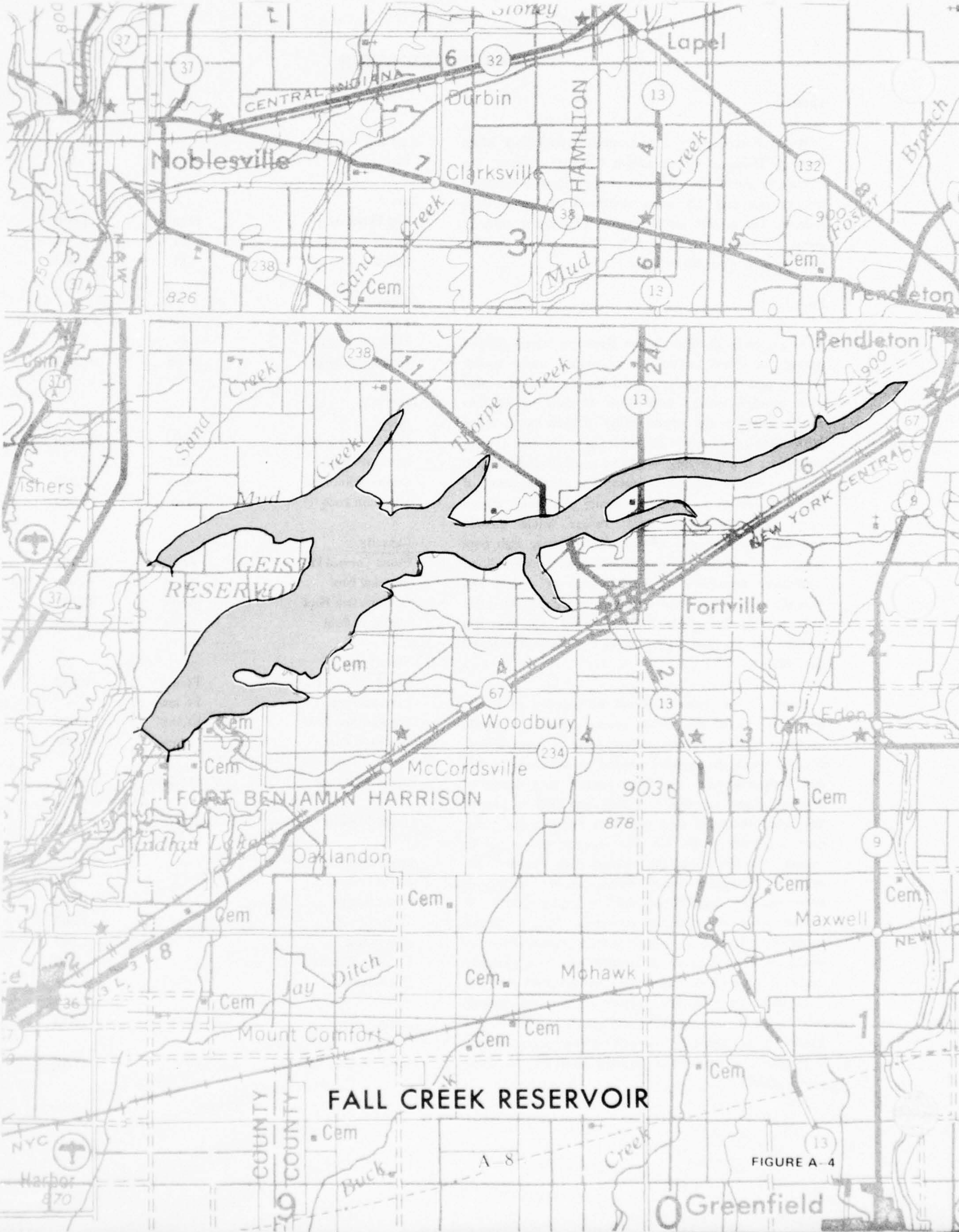
Parker Reservoir would be located on West Fork White River in Delaware and Randolph Counties, Indiana. The damsite is about one mile west of the Delaware-Randolph County line and 2.5 miles southwest of Parker City, Indiana. The project would control 175 square miles or about 3.3 percent of the total 5,330 square mile drainage basin of West Fork White River.

Plan

As presently planned, Parker Reservoir would provide storage for flood control, water supply, water quality control, and recreational purposes. The dam would consist of a concrete section with three 37 foot by 40 foot tainter gates in the stream valley flanked by a rolled earth fill section with a 30 foot top width and 1 on 3 side slopes having a total length of approximately 36,000 feet. A barrier dam for protection of the town of Farmland would be required across the small stream which drains the town area. Pumps would provide drainage both here and at Parker City during high pool stages. Preliminary geological investigations indicate satisfactory conditions for development of a dam and reservoir at this site. The stream is post-glacial in origin and meanders in a wide U-shaped valley. The founding medium for the projects would be hard, compact glacial clay till.

Lands for the reservoir would be acquired to a level five feet above the flood control pool to provide freeboard against adverse effects such as wave action, saturation and stream bank erosion. A minimum of 300 feet horizontal from the flood control pool would be required where the five foot freeboard fails to provide this area. Additional land would be acquired for access areas and other public use. The reservoir area would be cleared two feet above the seasonal pool elevation. Six miles of improved roads would require raising or alterations and about sixteen miles of utility lines would require some alteration or relocation. Five cemeteries would be relocated to higher ground. Parker Reservoir would be situated in an agricultural area with extensive row crop production. Present forested areas are scattered throughout the pool area. Existing roads would provide good access to the reservoir perimeter. The project would include boat launching ramps, parking areas, general recreation sites, and other facilities necessary to assure public access.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	175
Dam		
Top Elevation	Ft, msl	1,040
Maximum Height	Ft	65
Length	Ft	36,000
Spillway		
Top of Gates	Ft, msl	1,032
Effective Length	Ft	120
Design Discharge	CFS	86,000
Reservoir		
Area		
Flood Control Pool	Acre	10,150
Seasonal Pool	Acre	--
Conservation Pool	Acre	7,230
Minimum Pool	Acre	900
Capacity		
Flood Control Pool	Ac-Ft	42,700
Seasonal Pool	Ac-Ft	--
Conservation Pool	Ac-Ft	82,000
Minimum Pool	Ac-Ft	8,300
Elevation		
Flood Control Pool	Ft, msl	1,032
Seasonal Pool	Ft, msl	--
Conservation Pool	Ft, msl	1,027
Minimum Pool	Ft, msl	1,000
Project First Cost	($1,000)	43,800
Annual Benefits and Cost	($1,000)	
Annual Benefits		
Flood Control		918
Water Supply		400
Water Quality		1,000
Recreation		1,560
Fish and Wildlife		50
Total Benefits		3,928
Annual Costs		2,670
Benefit to Cost Ratio		1.47



FALL CREEK RESERVOIR

FIGURE A-4

FALL CREEK RESERVOIR

Location

Several alternative reservoir sites have been investigated on Fall Creek, a tributary of West Fork White River. It was concluded that a detailed, full survey scope study would be required before final selection of a specific reservoir site would be made. Of the sites considered, the Highland site has received the most support from local interests. The Highland Reservoir would be located in Marion, Hamilton and Madison Counties, Indiana. The dam would be located in the vicinity of East 79th Street and about one mile downstream from the existing Geist Dam and two miles north of Fort Benjamin Harrison. The project would control 242 square miles or 76 percent of the total 318 square mile drainage area of Fall Creek.

Plan

This project would provide multipurpose storage to include flood control, water supply and environmental-recreational purposes. The dam would be a rolled earth fill with a gated concrete spillway. It would have a total length of 2,700 feet and a maximum height of about 80 feet. The reservoir would be situated in the well entrenched, wooded section of Fall Creek but upstream from the highly developed lower Mud Creek area and Fort Benjamin Harrison Military Reservation. Geological reconnaissance in the Fall Creek area indicated suitable foundation conditions for dam construction.

Lands would be acquired five feet above the flood control pool to provide against adverse effects such as wave action, saturation, and stream bank erosion. A minimum of 300 feet horizontal from the flood control pool would be required where the five foot freeboard fails to provide this area. The reservoir area would be cleared two feet above the seasonal pool. Approximately twelve miles of improved roads would require raising or relocating and about fifteen miles of utility and telephone lines would require alteration or relocation. The existing Guist Reservoir would be inundated by the operation of this project. Five known cemeteries in the reservoir area would be relocated or protected by levees. Planned wooded and landscaped areas would be considered in selected locations around the perimeter of the reservoir to further enhance the present natural scenic value of the area. Many of the smaller tributary streams could be kept in their natural state to preserve environmental quality of the area.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	242
Top Elevation	Ft, msl	828
Maximum Height	Ft	80
Length	Ft	2,700
Spillway		
Top of Gates	Ft, msl	820
Effective Length	Ft	
Design Discharge	CFS	
Reservoir		
Area		
Flood Control Pool	Acre	9,780
Conservation Pool	Acre	7,300
Minimum Pool	Acre	1,100
Capacity		
Flood Control Pool	Ac-Ft	77,400
Conservation Pool	Ac-Ft	132,800
Minimum Pool	Ac-Ft	12,900
Elevation		
Flood Control Pool	Ft, msl	820
Conservation Pool	Ft, msl	811
Minimum Pool	Ft, msl	776
Project First Cost	($1,000)	60,600
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		880
Water Supply		995
Water Quality		700
Recreation		2,733
Fish and Wildlife		50
Total Benefits		5,358
Annual Costs		3,700
Benefit to Cost Ratio		1.45

CRAWFORDSVILLE RESERVOIR

FIGURE A-5

CRAWFORDSVILLE RESERVOIR

Location

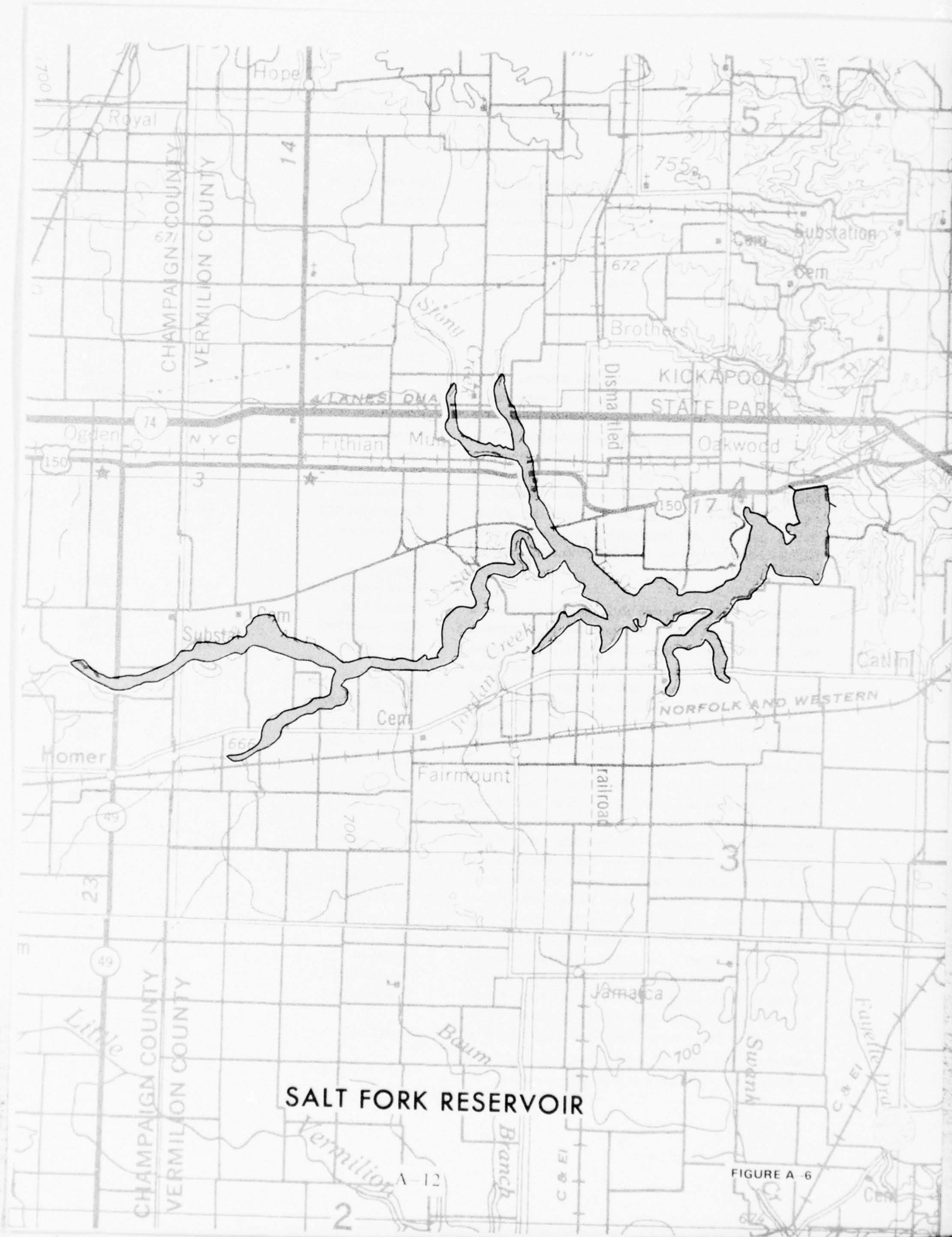
Crawfordsville Reservoir would be located on Sugar Creek, a tributary of the Wabash River in Montgomery County, Indiana. The selected damsite is located about 44 miles above the mouth of Sugar Creek and 3 miles northeast of Crawfordsville, Indiana. At this site, the project would control 423 square miles of the total 840 square mile Sugar Creek drainage basin.

Plan

As presently planned, Crawfordsville Reservoir would provide storage for flood control, water supply, water quality and environmental purposes. The dam would consist of a concrete section with five 40 foot by 40 foot tainter gates in the stream valley flanked by a rolled earth fill section with a 30 foot top width, 1 on 3 side slopes, and it would have a total length of 6,400 feet. Sluice gates would provide for regulated releases and normal flow through the spillway section, and two multistage outlets with reoxygenation facilities would control low flow and enhance downstream fisheries.

Sugar Creek has cut through glacial till to bedrock and is fairly well stabilized with gentle meandering in the reservoir area. The flat valley bottom rises abruptly to the adjacent prairie uplands with heavy forested slopes. Several small tributaries dissect the prairie land and enter the valley as sharp, deep entrenchments. These areas will be kept in the natural state wherever possible in addition to planned wooded areas in selected locations around the reservoir perimeter to improve the natural scenic values and enhance the recreation features of the project. Lands for the reservoir would be acquired to a level five feet above flood control pool or a horizontal distance of 300 feet from flood control pool, whichever is greater. This freeboard would protect against adverse effects such as wave action, saturation, and bank erosion. Additional land would be acquired for reservoir access and other public use. About one-half mile of State Highway 47 and two miles of secondary improved roads would be raised or relocated in addition to 4.6 miles of the Penn Central Railroad in the vicinity of Darlington, Indiana. An earth levee would provide protection for that portion of Darlington which would be subject to encroachment from the flood pool. The estimated project cost provides for the relocation of the covered bridge over Sugar Creek at Darlington. Ten miles of utility lines and one known cemetery in the reservoir area would require relocation.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	423
Dam		
Top Elevation	Ft, msl	778
Maximum Height	Ft	93
Length	Ft	6,400
Spillway		
Top of Gates	Ft, msl	770
Effective Length	Ft	200
Design Discharge	CFS	200,000
Reservoir		
Area		
Flood Control Pool	Acre	5,040
Seasonal Pool	Acre	3,750
Conservation Pool	Acre	3,350
Minimum Pool	Acre	1,470
Capacity		
Flood Control Pool	Ac-Ft	59,650
Seasonal Pool	Ac-Ft	22,560
Conservation Pool	Ac-Ft	78,960
Minimum Pool	Ac-Ft	22,560
Elevation		
Flood Control Pool	Ft, msl	770
Seasonal Pool	Ft, msl	761
Conservation Pool	Ft, msl	756
Minimum Pool	Ft, msl	722
Project First Cost	($1,000)	28,900
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		831
Water Supply		85
Water Quality		575
Recreation		785
Fish and Wildlife		50
Total Benefits		2,326
Annual Costs		1,760
Benefit to Cost Ratio		1.32



SALT FORK RESERVOIR

FIGURE A–6

SALT FORK RESERVOIR

Location

Salt Fork Reservoir would be located on Salt Fork, a tributary of the Vermilion River at approximate river mile 1.5. The reservoir would lie mostly in Vermilion County but would reach into Champaign County during flood operations. The project would control 515 of the 517 square mile Salt Fork drainage area.

Plan

The Salt Fork Reservoir, as presently planned, would provide storage for flood control, water quality control, and water oriented recreation.

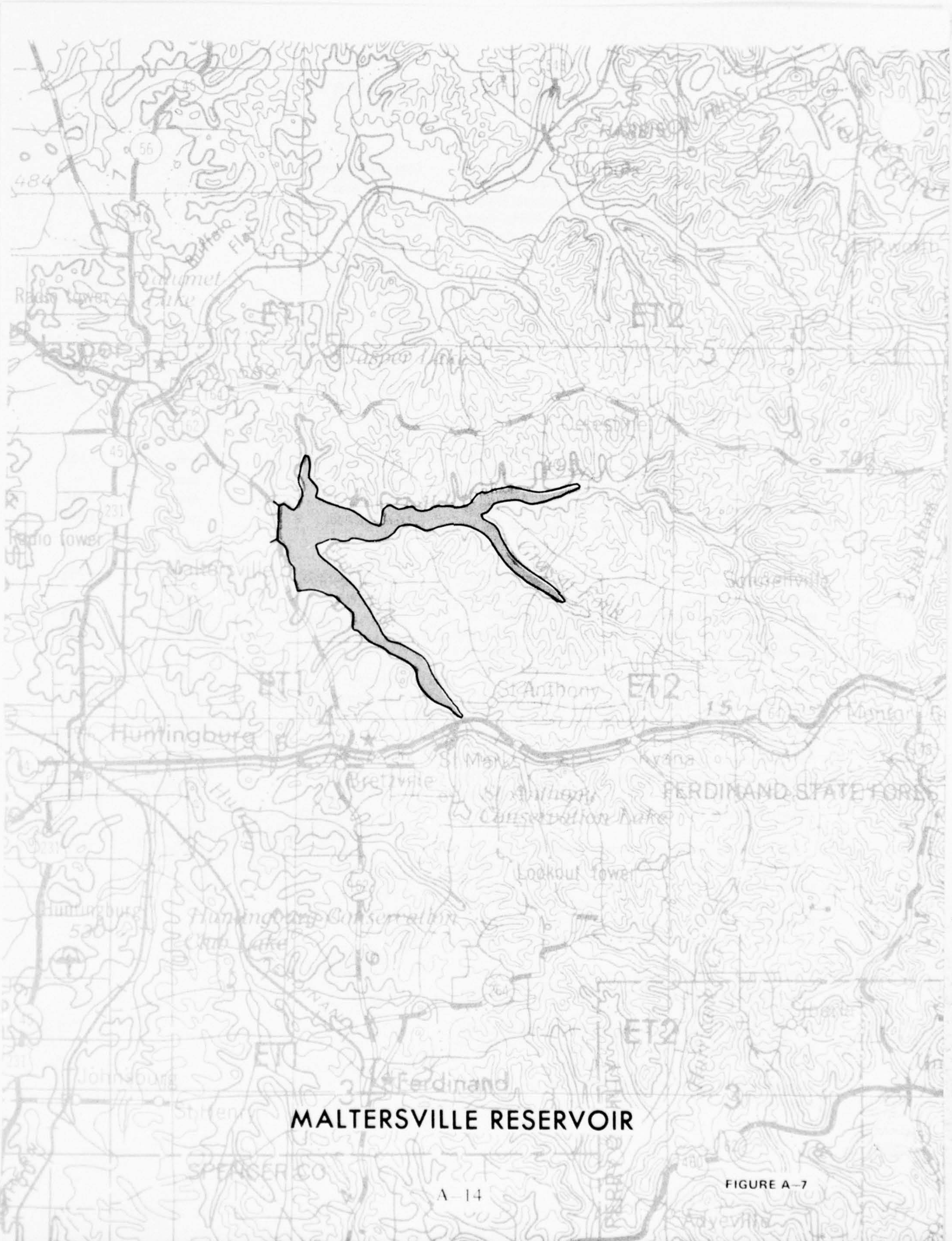
A gated, concrete spillway, equipped with five 40 x 50 foot tainter gates and five sluice gates together with flanking earth embankment sections, would constitute the control structures for the project. Total length of the dam, abutment to abutment, would be about 4,700 feet. Approximately 2,500 feet of the earth fill at the north end of the dam would serve primarily as a low earthen dike, which would be oriented in an east-west direction.

The dam would be founded on shale and sandstone overlain with glacial drift of the Bloomington Ridges Plain. Foundation conditions are generally suitable for construction of the dam and concrete spillway, although grouting would be required in the abutment areas to prevent possible solutioning. The stream meanders somewhat in the upper reaches of the valley. Much of the valley floor in the first five miles or so, upstream from the mouth, has been strip mined. The spoil areas have been reforested in many places and are now past of Kickapoo State Park. Forestry cover is limited almost entirely to the floor and hillsides of the valley. The uplands are almost flat with few trees and the land supports intensive grain production.

Lands for the project would be acquired to a level five feet above the flood control pool to provide freeboard against adverse effects such as wave action, saturation and bank erosion. Additional lands would be required for recreational use and for parking areas, launching ramps, and other facilities necessary for public recreational usage.

Relocations would include approximately 1.3 miles of road relocations, two known cemeteries, about 4,000 feet of the Penn Central Railroad and about six miles each of electric service and telephone lines. Federal highways and the Penn Central Railroad would be raised a minimum of three feet above the flood control pool while county roads would be raised one foot above the flood control pool.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	515
Dam		
Top Elevation	Ft, msl	645
Maximum Height	Ft	109
Length	Ft	4,700
Spillway		
Top of Gates	Ft, msl	637
Effective Length	Ft	200
Design Discharge	CFS	224,000
Reservoir		
Area		
Flood Control Pool	Acre	6,625
Seasonal Pool	Acre	—
Conservation Pool	Acre	3,250
Minimum Pool	Acre	1,375
Capacity		
Flood Control Pool	Ac-Ft	131,530
Seasonal Pool	Ac-Ft	—
Conservation Pool	Ac-Ft	71,000
Minimum Pool	Ac-Ft	27,470
Elevation		
Flood Control Pool	Ft, msl	637
Seasonal Pool	Ft, msl	—
Conservation Pool	Ft, msl	610
Minimum Pool	Ft, msl	580
Project First Cost	($1,000)	**36,200**
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		685
Water Supply		986
Water Quality		—
Recreation		870
Fish and Wildlife		50
Total Benefits		2,591
Annual Costs		2,208
Benefit to Cost Ratio		1.17



MALTERSVILLE RESERVOIR

FIGURE A–7

MALTERSVILLE RESERVOIR

Location

Maltersville Reservoir would be located on Straight Creek, a tributary of Patoka River in Dubois County, Indiana. The damsite is about three miles above the confluence with Patoka River and approximately four miles southeast of Jasper, Indiana. The project would control 62 square miles or 90% of the 67 square miles in the drainage area.

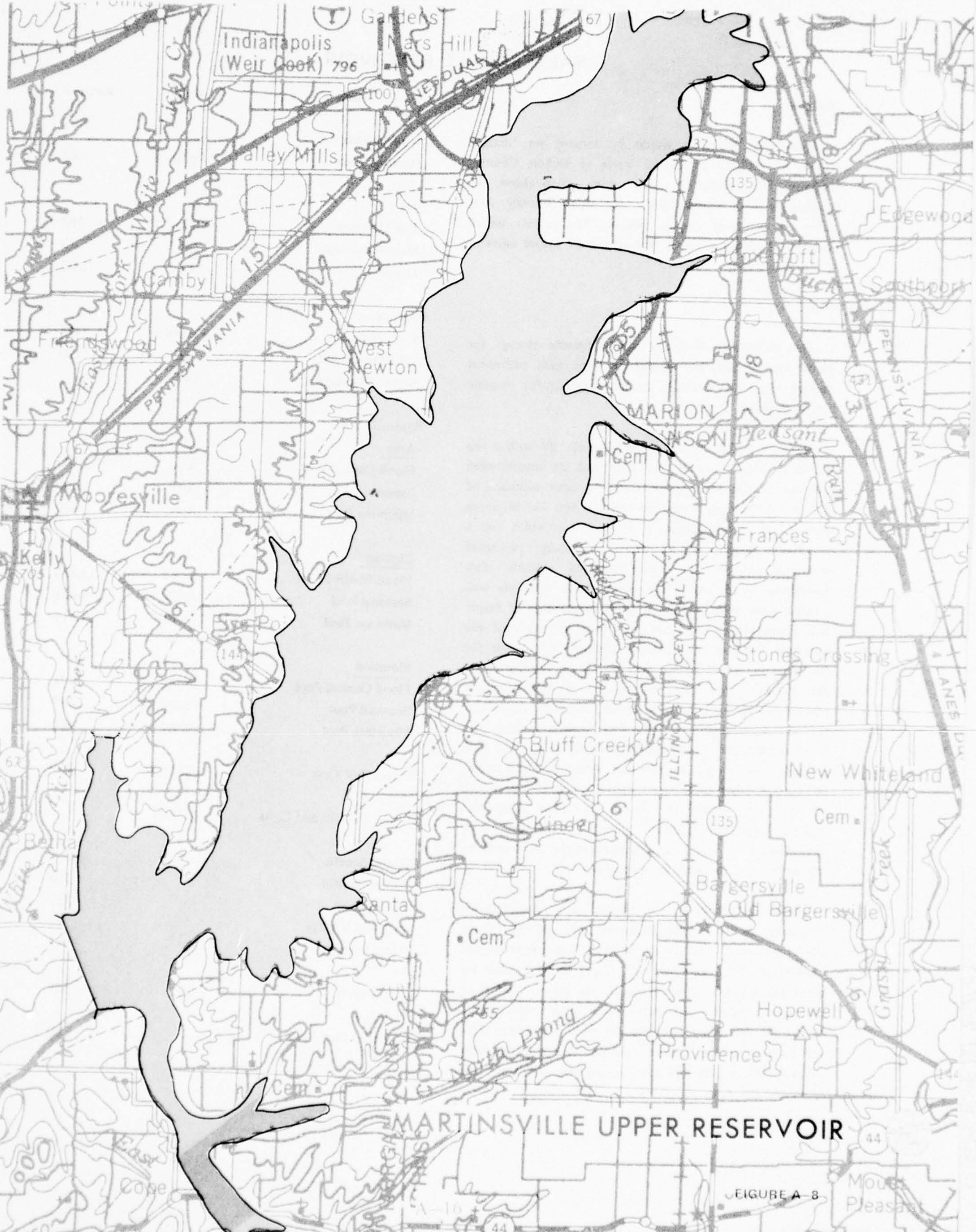
Plan

The Maltersville Reservoir would provide storage for flood control and recreational purposes with additional storage capability available in the reservoir for possible future demand.

Maltersville Dam would be rolled earth fill with a top elevation of 492 mean sea level and an uncontrolled spillway on the left abutment with a crest elevation of 474 m.s.l. The dam would be about 3,500 feet in length with 1 on 3 side slopes, a 30 foot top width and a maximum height of 52 feet. Preliminary geological reconnaissance in the area indicated suitable dam foundation conditions. The project site is relatively well located with respect to the nearby communities of Jasper and Huntingburg, and about twelve miles north of the approved location of Interstate Highway 64. Lands for the reservoir would be acquired to a level five feet above the flood control pool to provide freeboard against adverse effects such as wave action, saturation and bank erosion. A minimum of 300 feet horizontal from the flood control pool would be required where the five foot freeboard fails to provide this area. Additional land would be acquired for access areas and other public use. The reservoir area would be cleared two feet above the seasonal pool. Two miles of secondary roads and about twelve miles of utility lines would require alterations or relocations due to reservoir development.

Maltersville Reservoir is located near the western extremity of the rugged headwater area of the Patoka River watershed. The deeply dissected topography in the unglaciated area southeast of Jasper would result in numerous wooded inlets created by the reservoir. Most of the upland knolls and ridges have sparse forest cover except for the slopes adjoining the pool area. These areas will be kept in their natural state wherever practical, with reforestation of selected areas to enhance recreation and environmental features.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	62
Dam		
Top Elevation	Ft, msl	492
Maximum Height	Ft	52
Length	Ft	3,500
Spillway		
Crest Elevation	Ft, msl	474
Effective Length	Ft	120
Design Discharge	CFS	
Reservoir		
Area		
Flood Control Pool	Acre	2,500
Seasonal Pool	Acre	1,600
Minimum Pool	Acre	750
Capacity		
Flood Control Pool	Ac-Ft	19,880
Seasonal Pool	Ac-Ft	6,628
Minimum Pool	Ac-Ft	3,314
Elevation		
Flood Control Pool	Ft,msl	474
Seasonal Pool	Ft,msl	467
Minimum Pool	Ft,msl	461
Project First Cost	($1,000)	9,160
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		183
Recreation		337
Fish and Wildlife		48
Total Benefits		568
Annual Costs		559
Benefit to Cost Ratio		1.02



MARTINSVILLE UPPER RESERVOIR

FIGURE A-8

UPPER MARTINSVILLE RESERVOIR

Location

Upper Martinsville Reservoir would be located on West Fork White River in Morgan, Johnson and Marion Counties, Indiana. The damsite is about two miles southwest of the town of Centerton, Indiana. The project would control 2,110 square miles or approximately 40 percent of the total 5,330 square mile drainage area of West Fork White River.

Plan

As presently planned, Upper Martinsville Reservoir would provide storage for flood control and recreational purposes. The dam would be rolled earth fill with a gated concrete overflow section having six 30 x 50 foot taintor gates and twelve 5 x 7 foot sluice gates. The dam would be about 5,000 feet in length with 1 on 3 side slopes, a 30 foot top width and a maximum height of feet. The dam would be founded on glacial outwash sand and gravel about 90 feet thick in the valley bottom and the abutment foundation would consist of siltstone and shale. The topography is characterized by a broad flat river valley surrounded by highly dissected steep sided uplands with a dendritic drainage pattern. The valley is slightly less than one mile wide at the damsite and widens to greater than two miles wide, approximately one mile upstream.

Reservoir area lands would be acquired to a level five feet above the flood control pool to provide against adverse effects such as wave action, saturation, and bank erosion. A minimum of 300 feet horizontal from the flood control pool would be required where the five foot freeboard fails to provide this area. Additional land would be acquired for access areas and other public use. The reservoir area would be cleared two feet above the seasonal pool elevation. There are approximately 6.5 miles of improved roads within the reservoir area that would require raising or relocating. One of these roads, when raised, would serve as a dike to prevent the flood pool from flowing into Whitelick Creek. About 90 miles of utility line would require alterations or relocation. There are no known cemeteries in the reservoir area that would require relocating. The project would include boat launching ramps, parking areas, general recreation sites, and other related facilities necessary to assure public access.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	2,110
Dam		
Top Elevation	Ft, msl	675
Maximum Height	Ft	68
Length	Ft	5,000
Spillway		
Top of Gates	Ft, msl	667
Effective Length	Ft	300
Design Discharge	CFS	230,000
Reservoir		
Area		
Flood Control	Acre	18,800
Seasonal Pool	Acre	14,300
Minimum Pool	Acre	8,000
Capacity		
Flood Control Pool	Ac-Ft	307,000
Seasonal Pool	Ac-Ft	170,000
Minimum Pool	Ac-Ft	113,000
Elevation		
Flood Control Pool	Ft, msl	667
Seasonal Pool	Ft, msl	659
Minimum Pool	Ft, msl	645
Project First Cost	($1,000)	59,000
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		4,103
Recreation		2,500
Fish and Wildlife		120
Total Benefits		6,723
Annual Costs		3,600
Benefit to Cost Ratio		1.87

DEER CREEK RESERVOIR

A- 18

[redacted]

FIGURE A-9

[redacted]

DEER CREEK RESERVOIR

Location

Deer Creek Reservoir would be located on Deer Creek, a tributary of Wabash River, in Carroll County, Indiana. The damsite is about four miles upstream from the confluence of Deer Creek and Wabash River and two miles east of Delphi, Indiana. Deer Creek project would control 280 square miles or 95 percent of the total 295 square mile Deer Creek drainage basin.

Plan

As presently planned, Deer Creek Reservoir would provide storage for flood control, general recreation and fish and wildlife recreation although the small size of the seasonal pool would limit general recreation use.

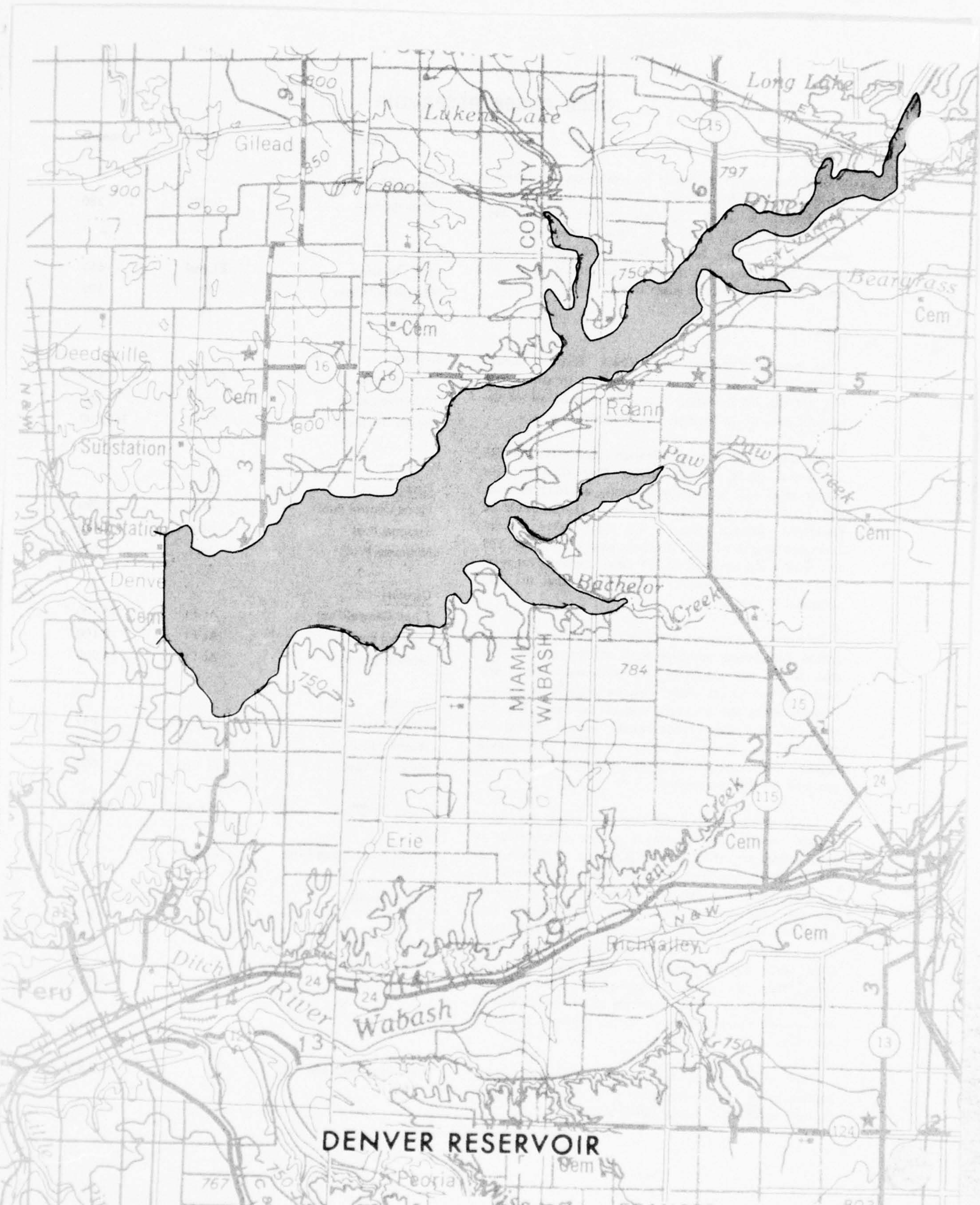
The dam would be a combination rolled earth fill with a concrete gated spillway having four 40 x 40 foot tainter gates with a discharge capacity of 163,000 cubic feet per second. Low flow and normal floods would be discharged through four 5 x 6 foot gated sluices. Maximum height of the structure would be about 103 feet with a top elevation of 655 mean sea level. An earth dike, 7,000 feet in length, would extend from the right abutment to high ground.

Preliminary geological investigation indicates that no critical foundation problems exist at the damsite. The dam would be constucted on moderately hard, well jointed, New Albany shale with an impervious blanket provided along the upstream side of the dam. Only 1.5 miles of secondary roads would require raising or relocating and about 12 miles of utility lines would require some alterations. Levee protection would be provided for five cemeteries.

Lands would be acquired five feet above the flood control pool to provide against adverse effects such as wave action, saturation, and bank erosion. A minimum of 300 feet horizontal from the flood control pool would be required where the five foot freeboard fails to provide this area. The reservoir area would be cleared two feet above the seasonal pool. Deer Creek valley is a fairly deep entrenchment in the Tipton glacial plain varying from about 600 to 2,000 feet wide. Valley walls are steep where the creek is entrenched in bedrock and becomes shallower in the overlying glacial drift. Most of the wooded cover is located on the south perimeter of the valley.

The project would include boat launching ramps, parking areas, general recreation sites, and other related facilities necessary to assure public access.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	280
Dam		
Top Elevation	Ft, msl	655
Maximum Height	Ft	103
Length	Ft	--
Spillway		
Top of Gates	Ft, msl	647
Effective Length	Ft	160
Design Discharge	CFS	163,000
Reservoir		
Area		
Flood Control Pool	Acre	2,790
Seasonal Pool	Acre	1,660
Minimum Pool	Acre	820
Capacity		
Flood Control Pool	Ac-Ft	75,100
Seasonal Pool	Ac-Ft	30,100
Minimum Pool	Ac-Ft	14,900
Elevation		
Flood Control Pool	Ft, msl	647
Seasonal Pool	Ft, msl	627
Minimum Pool	Ft, msl	602
Project First Cost	($1,000)	28,400
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		970
Recreation		494
Fish and Wildlife		50
Total Benefits		1,514
Annual Costs		1,732
Benefit to Cost Ratio		0.87



DENVER RESERVOIR

FIGURE A-10

DENVER RESERVOIR

Location

Denver Reservoir would be located on Eel River, a tributary of the Wabash River, in Miami and Wabash Counties, Indiana. The damsite is one mile east of Denver, Indiana and about 1.5 miles wast of Chili, Indiana. The project would control 680 square miles or 79 percent of the total 860 square mile drainage area of Eel River.

Plan

As presently planned, Denver Reservoir would provide storage for flood control, general recreation and fish and wildlife recreation. The dam would be rolled earth fill with a concrete gated spillway consisting of six 40 x 40 tainter gates with a discharge capacity of 250,000 cubic feet per second. Total length of the dam would be about 10,000 feet with a maximum height of 78 feet above the streambed. A top width of 30 feet with 1 on 3 side slopes, is proposed for the earth fill portion of the dam. An impervious blanket would be placed on the upstream side of the dam to prevent leakage. Preliminary geological investigation indicates this site to be structurally suitable for construction of an earth dam as proposed. The Eel River valley, within the proposed reservoir area, averages about 1.5 miles in width, with valley slopes gently rising to the upland plains. Forest cover is sparse along the border of the proposed pool area. Lands would be acquired to a level five feet above the flood control pool or a minimum of 300 feet horizontal from the flood control pool, whichever is greater, to provide freeboard against adverse effects such as wave action, saturation and bank erosion. Additional alnds would be acquired for reservoir access and other public use. The reservoir area would be cleared two feet above the seasonal pool elevation.

Approximately four miles of improved roads and fifteen miles of railroad would require raising or relocating. About 40 miles of utility lines would require alteration and it would be necessary to move five cemeteries to higher ground. The project would include boat launching ramps, parking areas, and general recreation sites with reforestation of selected areas around the perimeter of the reservoir to improve the scenic and recreational qualities of the project and provide additional woodland habitat for wildlife.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	680
Dam		
Top Elevation	Ft, msl	750
Maximum Height	Ft	78
Length	Ft	10,000
Spillway		
Top of Gates	Ft, msl	742
Effective Length	Ft	240
Design Discharge	CFS	250,000
Reservoir		
Area		
Flood Control Pool	Acre	13,550
Seasonal Pool	Acre	7,000
Minimum Pool	Acre	2,675
Capacity		
Flood Control Pool	Ac-Ft	226,700
Seasonal Pool	Ac-Ft	75,200
Minimum Pool	Ac-Ft	36,300
Elevation		
Flood Control Pool	Ft, msl	742
Seasonal Pool	Ft, msl	728
Minimum Pool	Ft, msl	712
Project First Cost	($1,000)	46,400
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		1,380
Recreation		1,450
Fish and Wildlife		75
Total Benefits		2,905
Annual Costs		2,830
Benefit to Cost Ratio		1.03

PIPE CREEK RESERVOIR

FIGURE A–11

PIPE CREEK RESERVOIR

Location

Pipe Creek Reservoir would be located on Pipe Creek a tributary of the Wabash River, in Miami County, Indiana with the extreme upper portion of the reservoir extending into Wabash County. The damsite is about 6.5 miles upstream from the mouth of Pipe Creek and approximately five miles southwest of Peru, Indiana. The project would control 167 square miles or about 87 percent of the total 193 square mile drainage area of Pipe Creek.

Plan

As presently planned, Pipe Creek Reservoir would provide storage for flood control and environmental purposes. The dam would consist of a concrete ogee spillway located on the left stream bank with rolled earth fill abutments. Five 30 x 40 foot tainter gates would discharge a flow of approximately 155,000 cubic feet per second. The concrete section would be founded on Silurian limestone with positive cutoffs to bedrock and into the glacial till of the abutments. The embankment section would have 1 on 3 side slopes, a 30 foot top width and a maximum height of about 74 feet. The Pipe Creek flood plain is generally about 1,000 feet wide and supports marginal crop production on the relatively small, narrow valley bottom. The stream gradient is fairly steep with an average fall of 12.6 feet per mile from the damsite of the mouth of Pipe Creek.

Lands for the reservoir would be acquired to a level five feet above or 300 feet horizontal from the flood control pool, whichever distance is the greater, to provide freeboard against adverse effects such as wave action, saturation and bank erosion. Additional land would be acquired for access areas and other public use. The reservoir area would be cleared two feet above the seasonal pool elevation. Relocation or alterations would be necessary for about 4.4 miles of highway and about 20 miles of utility lines. Four known cemeteries in the reservoir area would be moved to higher ground. The project would include boat launching ramps, parking areas, general recreation sites, and other related facilities necessary to assure public access. Provision would be made to reforest suitable areas around the reservoir perimeter to improve and enhance the recreational and wildlife environment.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	167
Dam		
Top Elevation	Ft, msl	780
Maximum Height	Ft	74
Length	Ft	14,000
Spillway		
Top of Gates	Ft, msl	772
Effective Length	Ft	200
Design Discharge	CFS	155,000
Reservoir		
Area		
Flood Control Pool	Acre	3,060
Seasonal Pool	Acre	1,440
Minimum Pool	Acre	600
Capacity		
Flood Control Pool	Ac-Ft	59,900
Seasonal Pool	Ac-Ft	26,400
Minimum Pool	Ac-Ft	8,900
Elevation		
Flood Control Pool	Ft, msl	772
Seasonal Pool	Ft, msl	753
Minimum Pool	Ft, msl	735
Project First Cost	($1,000)	21,200
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		778
Recreation		470
Fish and Wildlife		60
Total Benefits		1,308
Annual Costs		1,293
Benefit to Cost Ratio		1.01

[redacted] FIGURE A–12

DELPHI UPPER RESERVOIR

Location

Delphi Upper Reservoir would be located on the main stem of the Wabash River at about river mile 333 in Carroll and Cass Counties, Indiana. The damsite is 1.5 miles northeast of Delphi, Indiana and would control 4,136 square miles of the total 33,100 square mile drainage basin of the Wabash River.

Plan

As presently planned, Delphi Upper Reservoir would provide storage for flood control and environmental purposes. The dam would consist of ten 40 x 50 foot tainter gates with a discharge capacity of 530,000 cubic feet per second and sixteen 6 x 9 foot sluice ways, equipped with multistage reoxygenation facilities. Maximum height of the dam would be about 92 feet above the streambed and the total length would be about 5,500 feet. Previous geological investigations indicate conditions are satisfactory for construction of the dam at this site. A system of levees and floodwalls at Logansport would permit economical storage to the flood control pool elevation. The reservoir would provide a recreation pool of about 8,400 acres. From the mouth of Pleasant Run of Rattlesnake Creek, on the right bank, the heavily wooded valley wall rises gently to the upland area with an average slope of about 20 percent. This rim of the reservoir would likely support most of the recreational development for the project. Forest cover is sparse on the left shoreline and at back from the seasonal pool in most areas.

Lands for the reservoir would be acquired to a level five feet above the flood control pool to provide freeboard against adverse effects such as wave action, saturation, and bank erosion. A minimum of 300 feet horizontal from the flood control pool would be required where the five foot freeboard fails to provide this area. Additional land would be acquired for access areas and other public use. The reservoir area would be cleared two feet above the seasonal pool elevation. There are about 13 miles of improved roads and 1.6 miles of railroad that would require raising or relocating. Approximately 26 miles of utility line would need alteration or relocation and three cemeteries would be moved to higher ground.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	4,136
Dam		
Top Elevation	Ft, msl	613
Maximum Height	Ft	92
Length	Ft	5,500
Spillway		
Top of Gates	Ft, msl	600
Effective Length	Ft	500
Design Discharge	CFS	530,000
Reservoir		
Area		
Flood Control Pool	Acre	15,500
Seasonal Pool	Acre	12,000
Minimum Pool	Acre	7,350
Capacity		
Flood Control Pool	Ac-Ft	404,000
Seasonal Pool	Ac-Ft	183,400
Minimum Pool	Ac-Ft	110,000
Elevation		
Flood Control Pool	Ft, msl	600
Seasonal Pool	Ft, msl	584
Minimum Pool	Ft, msl	565
Project First Cost	($1,000)	76,900
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		2,510
Recreation		1,862
Fish and Wildlife		80
Total Benefits		4,452
Annual Costs		4,691
Benefit to Cost Ratio		0.95

COAL CREEK RESERVOIR

FIGURE A-13

COAL CREEK RESERVOIR

Location

Coal Creek Reservoir would be located in the southwest corner of Fountain County, Indiana. The damsite is located about four miles above the mouth of Coal Creek and approximately one mile north of the Fountain-Parke County line. The project would control 256 square miles or 97 percent of the total 264 square mile drainage basin of Coal Creek.

Plan

As presently planned, Coal Creek Reservoir would provide storage for flood control and environmental purposes. The dam would consist of a rolled earth fill with an uncontrolled spillway located on the right bank about 2,000 feet northwest of the dam, discharging into Coal Creek one-half mile downstream from the dam. An impervious upstream blanket with downstream relief wells would be provided for seepage control. A concrete circular conduit with a capacity of 3,100 cubic feet per second and multilevel outlets for reoxygenation of water for low flow control would be provided. The dam would be founded on glacial deposits of clay till, sand, and gravel which should provide a suitable foundation. The reservoir would extend up Coal Creek about twelve miles to the southern edge of Veedersburg, Indiana.

Lands would be acquired five feet above the flood control pool to provide against adverse effects such as wave action, saturation, and bank erosion. A minimum of 300 feet horizontal from the flood control pool would be required where the five foot freeboard fails to provide this area. The reservoir area would be cleared two feet above the seasonal pool. About three miles of improved secondary roads would require raising or relocating and about ten miles of utility lines would require alteration or relocation. Five known cemeteries in the reservoir area would be relocated. Coal Creek Reservoir would be contained in a relatively narrow valley averaging about 2,000 feet in width. The numerous side channel inlets with heavily wooded slopes would enhance the recreational qualities of the reservoir area. The project would include boat launching ramps, parking areas, and general recreation sites and other public use.

Data	Unit	Amount
Dam and Reservoir		
Drainage Area	Sq Mi	256
Dam		
Top Elevation	Ft, msl	590
Maximum Height	Ft	102
Length	Ft	—
Spillway		
Crest Elevation	Ft, msl	570
Effective Length	Ft	—
Design Discharge	CFS	—
Reservoir		
Area		
Flood Control Pool	Acre	5,260
Seasonal Pool	Acre	2,600
Conservation Pool	Acre	1,870
Minimum Pool	Acre	1,020
Capacity		
Flood Control Pool	Ac-Ft	129,300
Seasonal Pool	Ac-Ft	27,300
Conservation Pool	Ac-Ft	27,300
Minimum Pool	Ac-Ft	13,650
Elevation		
Flood Control Pool	Ft, msl	570
Seasonal Pool	Ft, msl	544
Conservation Pool	Ft, msl	532
Minimum Pool	Ft, msl	514
Project First Cost	($1,000)	19,000
Annual Benefits and Costs	($1,000)	
Annual Benefits		
Flood Control		533
Recreation		580
Fish and Wildlife		50
Total Benefits		1,163
Annual Costs		1,160
Benefit to Cost Ratio		1.00

TABLE A–1. PHYSICAL DATA FOR STRUCTURAL MEASURES IN SMALL WATERSHED PROJECTS RECOMMENDED FOR EARLY ACTION INSTALLATION

Hydrologic subarea and watershed name	CNI no	Purpose [1]	Project area	No of strs	Drainage area controlled	Storage area: Flood prevention: Sediment	Storage area: Flood prevention: Detention	Storage area: Other uses	Storage area: Total storage	Storage area: Permanent pool	Storage area: Top of dam	Additional storage capacity available	Maximum potential surface area	Channel improvement	Annual visitor days provided
			(sq mi)	(no)	(sq mi)	(ac ft)	(ac ft)	(ac ft)	(ac ft)	(ac)	(ac)	(ac ft)	(ac)	(miles)	(no)
Upper Wabash River															
Clear Creek (UW 4)	17-9	FP,D	49.1			DATA NOT PRESENTLY AVAILABLE									
Little River (UW 5) [2]	17-8	FP,R,D,WQ	286.6	7	71.6	1,480	9,090	13,640	24,210	440	2,300		1,350	28.4	88,000
Buckeye-Hoosier (UW 9-20)	17-2-3	FP, R, WQ, D	390.6	4	175.7	6,710	22,450	18,770	47,930	1,040		54,660	5,630	57.5	288,660
Salamonie River (S-15)	17-12	FP, D, R	260.0	1	3.4	130	770	480	1,380	110	250	–	110	46.0	106,800
Pony Creek (Eel-12)	17b-3	FP, D	33.3	–	–	–	–	–	–	–	–	–	–	12.8	–
Lower Mississinewa River (M7 thru M15)	17a-2	FP, R, F&WL	341.0	2	16.1	560	1,210	2,930	4,700	310	750	–	310	–	77,500
Upper Mississinewa River (M16 & 17)	17a-1	FP, D	343.0	–	–	–	–	–	–	–	–	–	–	20.0	–
Brown-Hill (T-9)	17c-21	FP, D	86.0	–	–	–	–	–	–	–	–	–	–	31.5	–
Big Monon Ditch (T-13)	17c-20	FP, D	167.5	–	–	–	–	–	–	–	–	–	–	55.6	–
House-Bartee (T-32&33)	17c-9	FP, D	28.8	–	–	–	–	–	–	–	–	–	–	20.3	–
Mud Creek (T-36)	17c-7	FP, D	105.0	–	–	–	–	–	–	–	–	–	–	38.2	–
Sugar Creek (MS-77)	17-39	FP, D, R	29.3	1	26.7	1,420	4,380	5,380	11,180	330	570	–	330	10.6	135,900
Rock Creek (Cass Co) (MS-83)	17-33	FP, D	88.3	–	–	–	–	–	–	–	–	–	–	18.4	–
Burnetts Creek (MS-85)	17-31	FP, D	21.7	–	–	–	–	–	–	–	–	–	–	9.8	–
Crooked Creek (MS-87)	17-31	FP, D	60.6	–	–	–	–	–	–	–	–	–	–	14.5	–
Goose Creek (MS-103)	17-26	FP, R	3.4	3	1.4	110	310	310	730	50	80	–	50	1.0	12,500
Subtotal			2,294.2	18	294.9	10,410	38,210	41,510	90,130	2,280	3,950	54,660	7,780	364.6	709,360
West Fork White River															
Veale Creek (WFW-2)	17hl-49	FP, R	38.3	4	10.0	370	1,660	170	2,200	110	570	–	–	8.0	40,000
Black Creek (WFW-9)	17hl-45	FP, R, WQ, D	139.9	2	3.8	320	720	1,480	2,520	210	290	750	210	37.2	42,950
Lagoon Ditch, Wabash and Erie Canal (WFW-24&26)	17hla-14&16	FP	37.2	–	–	–	–	–	–	–	–	–	–	21.0	–
Splunge Creek (WFW-29)	17hla-13		44.9			DATA NOT PRESENTLY AVAILABLE									
Birch Creek (WFW-30)	17hla-11	FP, WQ	66.7	6	24.3	2,090	5,770	4,500	12,360	280	1,460	10,410	1,330	–	–
Jordan Creek (WFW-33)	17hla-8	FP, R	37.7	4	16.7	1,050	3,090	9,000	13,140	450	610	12,540	940	–	85,750
Croys Creek (WFW-35)	17hla-6	FP, R	39.7	3	14.3	720	2,890	2,770	6,380	290	760	4,240	560	4.3	132,500
Deer Creek (WFW-37)	17hla-4	FP, R	91.1	1	43.4	2,310	8,720	15,740	26,770	850	1,290	12,070	1,200	–	143,250
Little Walnut (WFW-38)	17hla-2	FP, R	64.4	3	30.7	1,625	6,180	4,930	12,735	460	1,040	–	–	–	45,000
Rattlesnake Creek (WFW-43)	17hl-30	FP, R	23.7	1	13.2	990	2,870	9,680	13,540	420	560	–	430	–	112,250
Bryant Creek (WFW-52)	17hl-25	FP, R	11.4	1	4.5	240	930	1,420	2,590	110	200	1,180	160	–	42,750
Whitelick Creek (WFW-60)	17hl-20	FP, R, WQ	282.8	7	122.6	8,180	21,690	10,280	40,150	820	2,400	5,800	1,230	–	189,800
Killbuck Creek (WFW-84)	17hl-3	FP, D	107.4	–	–	–	–	–	–	–	–	–	–	29.1	–
Wilson Creek (WMS-5)	17h-3	FP,R,WQ,M&I	17.2	1	5.5	590	1,420	2,850	4,860	330	620	–	330	4.0	82,500
Subtotal			1,002.4	33	289.0	18,485	55,940	62,820	137,245	4,330	9,800	46,990	6,390	103.6	916,750
East Fork White River															
Aikman Creek (EFW-2)	17h2-45	FP, D	34.7	4	16.3	260	2,630	–	2,890	110	670	5,510	730	7.0	–
Lost River (EFW-10)	17h2-41	FP, R, M&I	365.1	11	216.3	5,490	26,940	10,810	43,240	1,640	4,400	7,225	2,000	44.0	152,800
Upper Vernon Fork (EFW-30U)	17h2b-1	FP, R, M&I, WQ	196.0	5	182.6	9,740	60,470	34,170	104,380	2,470	5,720	–	2,930	–	120,000
Lower Vernon Fork (EFW-30L)	17h2b-2	FP,R,D,F&WL	217.2	13	80.7	3,180	16,730	6,160	26,070	990	3,710	7,000	1,550	64.0	90,000
Pond Creek (EFW-27)	17h2b-7	FP, R, D	25.7	2	9.6	720	2,100	3,200	6,020	520	960	530	590	9.9	113,200
Little Salt Creek (EFW-37)	17h2-23	FP	53.7	3	25.7	1,380	4,480	–	5,860	120	670	28,880	1,280	–	–
White Creek and Beatty-Walker Ditch (EFW-42&43)	17h2-15	FP, R, D	130.5	14	51.1	3,810	11,320	15,030	30,160	1,880	4,260	50,840	5,320	39.1	231,900
Denios Creek (EFW-48)	17h2-10	FP, R	17.9	3	6.8	500	1,400	3,400	5,300	390	520	4,880	890	–	160,500
Lewis Creek (EFW-52)	17h2-5	FP, D	81.0	–	–	–	–	–	–	–	–	–	–	27.5	–
Upper Big Flatrock River (EFW-54)	17h2-1	FP, M&I, F&WL, D	295.8	2	24.0	1,270	3,950	6,770	11,990	790	1,480	–	790	52.1	50,800
Delaney Creek (EFW-25)	17h2b-8	FP, I, R	34.2	5	12.3	200	2,200	1,400	3,800	160	–	–	–	8.5	54,600
Brandywine Creek (EFW-61)	17h2a-4	FP, D	108.0	–	–	–	–	–	–	–	–	–	–	26.2	–
Little Blue River (EFW-63)	17h2a-3	FP	105.8	1	69.0	3,640	13,220	–	16,860	230	1,290	8,860	900	13.1	–
Subtotal			1,665.6	63	694.4	30,190	145,440	80,940	256,570	9,300	23,680	113,725	16,980	291.4	973,800
Middle Wabash River															
Vieke Ditch (MS-12)	17-105	FP, D	49.9	–	–	–	–	–	–	–	–	–	–	13.2	–
Raccoon Creek (Illinois) (MS-14)	17-107	FP, D	77.3	–	–	–	–	–	–	–	–	–	–	18.9	–
City Ditch (MS-15)	17-103	FP, D	15.9	–	–	–	–	–	–	–	–	–	–	10.8	–
Snapp-Kelso (MS-19)	17-103	FP, R	24.3	1	5.6	550	1,300	1,100	2,950	200	–	–	–	–	50,000
Mariah Creek (MS-21)	17-102	FP, R, D	105.1	2	9.6	640	1,810	–	2,450	90	520	6,030	630	20.7	12,500

TABLE A–1. PHYSICAL DATA FOR STRUCTURAL MEASURES IN SMALL WATERSHED PROJECTS RECOMMENDED FOR EARLY ACTION INSTALLATION (CONTINUED)

Hydrologic subarea and watershed name	CNI no	Purpose[1]	Project area	No. of strs	Drainage area controlled	Storage area: Flood prevention: Sediment	Storage area: Flood prevention: Detention	Storage area: Other uses	Storage area: Total storage	Storage area: Permanent pool	Storage area: Top of dam	Additional storage capacity available	Maximum potential surface area	Channel improvement	Annual visitor days provided
			(sq mi)	(no)	(sq mi)	(ac ft)	(ac ft)	(ac ft)	(ac ft)	(ac)	(ac)	(ac ft)	(ac)	(miles)	(no)
Middle Wabash River (Cont'd)															
Lower Shaker Prairie (MS-22)	17-101	FP, D	25.0	–	–	–	–	–	–	–	–	–	–	10.1	–
Turtle Creek (MS-29)	17-93	FP, R, I	38.3	8	15.9	590	3,510	2,370	6,470	405	1,170	–	–	10.0	30,000
Mill Creek (MS-34) (Illinois)	17-87	FP, R	127.9	8	65.3	2,330	16,700	18,560	37,590	1,070	2,520	–	–	39.4	159,760
Snyder Creek (Illinois) (MS-35)	17-85	FP	16.9	1	5.8	430	1,570	–	2,000	50	260	970	150	5.1	–
Honey Creek (MS-42)	17-77	FP, R	95.8	8	30.5	1,400	6,280	900	8,580	375	1,820	9,520	1,300	17.6	55,400
Sugar Creek (MS-44) (Illinois) [2]	17-75	FP, M&I, WQ	96.6	2	48.7	2,210	10,440	25,070	37,720	770	970	2,310	990	–	
Otter Creek (MS-47)	17-71	FP, R	126.4	5	61.4	1,980	11,860	6,700	20,540	920	2,460	16,500	1,660	7.0	225,000
Coal Creek (MS-55)	17-55	FP, R	263.8	2	77.4	3,160	15,760	4,530	23,450	500	1,300	1,580	690	–	111,500
Fall Creek (MS-64)	17-51	FP, R	7.6	1	3.4	160	550	600	1,310	60	150	–	–	–	25,000
Feather Creek (MS-101)	17-68	FP, R	8.1	1	3.7	280	980	3,910	5,170	240	330	–	240	0.5	83,700
Big Raccoon Creek (BR-4)	17-62	FP, R, F&WL	208.0	8	109.5	3,810	17,410	3,000	24, 220	770	3,850	–	–	14.8	107,470
Jordan Creek (V-7)	17e-7	FP, D	114.1	–	–	–	–	–	–	–	–	–	–	24.6	–
Lye Creek (SC-14)	17f-3	FP, D	77.8	–	– –	–	–	–	–	–	–	–	–	42.9	–
Subtotal			1,478.8	47	436.8	17,540	88,170	66,740	172,450	5,450	15,350	36,910	5,660	235.6	860,330
Embarras River															
Brushy-Birch Creek (E 3&4)	17g-3&4	FP, R, WQ	65.9	5	10.9	850	2,470	4,220	7,540	380	570	2,350	570	17.5	96,400
Muddy Creek (E 5) [2]	17g-5	FP,D,WQ	100.9	2	11.1	800	3,045	645	4,490	150	610	–	150	18.0	–
North Fork Embarras River (E 11)	17g-11	FP, R, WQ, M&I	356.8	12	167.2	9,410	36,990	15,610	62,010	1,720	5,600	31,690	4,240	56.4	316,550
Crooked Creek (E 12)	17g-12	FP, R	77.9	5	49.1	2,810	11,760	870	15,440	520	1,730	–	530	12.1	55,900
Muddy Creek (E 21)	17g-21	FP, R, M&I, WQ	215.5	6	113.0	6,525	27,940	16,985	51,450	1,630	3,220	5,430	1,600	–	172,300
Brushy Creek (E 33)	17g-33	FP	56.6	–	–	–	–	–	–	–	–	–	–	17.0	–
Subtotal			873.6	30	351.3	20,395	82,205	38,330	140,930	4,400	11,730	39,470	7,090	121.0	641,150
Lower Wabash River															
Big Creek (MS 1)	17-125	FP, R, D	254.4	10	146.6	5,845	18,600	6,400	30,845	2,060	6,200	6,000	2,740	25.7	95,680
Gresham Creek (MS 3)	17-121	FP, R, D	15.9	13	9.8	830	2,215	3,440	6,485	390	–	–	–	9.8	148,000
McHenry-Hawthorne					DATA NOT PRESENTLY AVAILABLE										
Scott Ditch and Coffee Bayou (MS 6&8)	17-113	FP, R, D	80.2	3	10.8	355	3,020	8,360	11,735	850	1,270	3,840	1,500	38.0	267,550
Bonpas Creek (MS 100) [2]	17-117	FP,R,WQ,D,M&I	270.6	9	60.8	4,640	17,820	3,785	26,245	890	3,790	6,930	1,660	54.0	161,400
Subtotal			621.1	35	228.0	11,670	41,655	21,985	75,310	4,190	11,260	16,770	5,900	127.5	672,630
Little Wabash River															
Lick Creek (LW 2)	17j-2	FP, R	19.8	2	4.7	380	1,290	2,700	4,370	230	290	1,460	320	5.1	109,000
Auxier-Big Creek (LW 12)	17jl-12	FP, R, M&I, D	226.0	4	31.7	1,540	5,610	6,150	13,300	920	1,350	–	1,390	7.5	75,000
Big Mound (LW 14)	17jl-14	FP, D	35.9	1	3.4	250	1,060	–	1,310	40	240	380	110	11.7	–
Dry Fork (LW 15)	17jl-15	FP, R, M&I	78.8	4	46.9	3,760	13,610	1,500	18,870	630	2,180	2,980	1,110	9.1	128,700
Horse Creek (LW 18)	17jl-18	FP, R, M&I	108.3	5	41.7	3,080	14,100	5,820	23,000	770	1,920	1,650	1,080	21.3	148,000
Pond Creek (LW 28&29)	17j-28&29	FP, R	53.9	1	3.1	170	1,190	1,340	2,700	190	310	–	240	11.0	55,440
Fox River (LW 39)	17j-39	FP, R, M&I, WQ	195.2	5	69.0	4,410	18,380	14,320	37,110	1,820	3,130	380	1,880	36.3	110,200
Big Muddy Creek (LW 42)	17j-42	FP, R	312.0	7	115.1	7,260	30,800	4,600	42,660	1,000	3,530	9,190	2,070	22.7	252,850
Salt Creek (LW 51)	17j-51	FP, R	93.7	4	60.0	3,830	14,960	4,000	22,790	750	1,780	3,430	930	5.9	77,500
Upper Little Wabash River (LW 52)	17j-52	FP,WQ,M&I	377.0	7	117.5	7,510	28,270	13,280	49,060	1,690	3,700	12,090	2,240	9.1	–
Subtotal			1,500.6	40	493.1	32,190	129,270	53,710	215,170	8,040	18,430	31,560	11,370	139.7	956,690
Patoka															
Hunley-Ell (P 20 & 21)	17i-6	FP,R,WQ,M&I	100.6	8	27.9	2,120	6,310	21,890	30,320	1,615	–	14,260	2,690	33.3	105,000
Upper Patoka River Tributary (P 32 & 34)	17i-3	FP,WQ,M&I	111.8	5	16.2	1,160	2,410	210	3,780	180	–	18,130	920	–	–
Hall-Flat Creek (P 22)	17i-4	FP,R,WQ,M&I	68.0	8	14.1	825	5,500	4,610	10,935	350	800	–	–	19.0	50,000
Subtotal			280.4	21	58.2	4,105	14,220	26,710	45,035	2,145	800	32,390	3,610	52.3	155,000
TOTAL			9,716.7	287	2,845.7	144,985	595,110	392,745	1,132,840	40,135	95,000	372,475	64,780	1,435.7	5,885,710

1/ FP - Flood prevention; M&I - Municipal and industrial water supply; WQ - Water quality control; I - Irrigation; R - Recreation; F&WL - Fish and wildlife; D - Drainage.

2/ Final plan formulation showed the potential for both water supply and water quality storage. Storage and cost data shown are tentative and preliminary.

TABLE A-2. EARLY ACTION SMALL WATERSHED PROJECTS RECOMMENDED FOR INSTALLATION IN NATIONAL AND STATE FORESTS

(These watersheds are included in other tables but are identified here to emphasize the National and State forest opportunities)

Hydrologic subarea	Hydrologic unit no	Watershed name	Forest	National or state forest land area acres 1/	Total drainage area acres	Proposed structures SP & MP 2/ 5/	Surface area acres 3/ 6/	Purpose 4/
INDIANA								
East Fork White River	EFW-10	Lost River	Hoosier National	12,200	233,690	11 (8)	2,977 (2,292)	FP, Rec, M&I
	25	Delaney Creek	Jackson Washington	5,000	21,905	5 (3)	277 (201)	FP, Rec, Irrigation
	27	Pond Creek	Jackson Washington	1,300	16,448	2 (1)	580 (90)	FP, Rec, Drainage
	30	Vernon Forks	Selmier	352	283,365	19 (0)	6,673 (-)	FP, Rec, M&I, Drainage
	37	Little Salt Creek	Hoosier National	12,445	34,560	3 (3)	435 (435)	FP
	42 & 43	White Creek and Beatty Walker Ditch	Hoosier National	1,270	83,200	14 (4)	3,035 (675)	FP, Rec, Drainage
		SUBAREA TOTAL	State Forest	6,652	321,718	26 (4)	7.530 (291)	
			National Forest	25,915	351,450	28 (15)	6,447 (3,402)	
Patoka River	P-22	Straight River	Ferdinand	600	43,520	8 (2)	798 (49)	FP, Rec, M&I, WQC
	32 & 34	Upper Patoka River	Hoosier National	None	71,552	5 (2)	327 (107)	FP, M&I, WQC
		SUBAREA TOTAL		600	115,072	13 (4)	1,125 (156)	
West Fork White River	WFW-9	Black Creek	Green Sullivan	5,180	85,510	2 (0)	208 (-)	FP, Rec, M&I, WQC and Drainage
	33	Jordan Creek	Owen Putman	2,205	24,141	4 (2)	650 (220)	FP, Rec
	43	Rattlesnake Creek	Owen Putman	1,280	15,142	1 (1)	470 (470)	FP, Rec
	52	Bryant Creek	Morgan Monroe	3,250	7,302	1 (1)	140 (140)	FP, Rec
		SUBAREA TOTAL		11,915	132,095	8 (4)	1,468 (830)	
		BASIN TOTALS		45,082	920,335	75 (27)	16,570 (4,679)	

1/ National and State forest acreage to 30 June 1967.
2/ Single purpose and multipurpose.
3/ Maximum area, emergency spillway level. In most cases additional storage is available to include recreation use, if necessary.
4/ FP - Flood Prevention; Rec - Recreation; M&I - Municipal and Industrial; Irr - Irrigation; Drain - Drainage; WQC - Water Quality Control.
5/ Structures whose drainage area lies partially or completely within National Forest boundary or includes State forest lands.
6/ Total surface area of 5/.

TABLE A–3. COST DATA FOR SMALL WATERSHED PROJECTS RECOMMENDED FOR EARLY ACTION INSTALLATION

Hydrologic subarea and watershed name	CNI no.	Flood prevention	Recreation	Municipal and industrial	Water quality control	Fish and wildlife	Irrigation	Drainage	Subtotal structural cost	Land treatment cost[1]	Total project installation cost
		Purpose (dollars)									
Upper Wabash River											
Little River (UW-5) [10]	17-8	1,280,342	641,741		2,226,000			391,680	4,539,763	4,114,098	8,653,861
Buckeye-Hoosier (UW-9-20)	17-2,3	5,788,124	3,409,862		462,110			19,950	9,680,046	4,808,559	14,488,605
Salamonie River (S-15)	17-12	3,270,039	404,741					109,480	4,345,870 [4]	2,049,930	6,395,800
Lower Mississinewa River (M-7-15)	17a-2	136,200	417,800			430,000			984,000	1,500,000	2,484,000
Upper Mississinewa River (M-16-17)	17a-1	2,420,390						121,020	2,541,410	3,000,000	5,541,410
Rock Creek (Cass) (MS-83)	17-33	773,839						268,036	1,041,875	421,085	1,462,960
House-Bartee D. (T-32-33)	17c-9	584,100						210,100	794,200	412,543	1,206,743
Clear Creek (UW-4)	17-9	238,600						238,600	477,200	759,875	1,237,075
Sugar Creek (MS-77)	17-39	190,050	1,649,300					190,050	2,029,400	395,052	2,424,452
Burnetts Creek (MS-85)	17-31	185,500						69,800	255,300	249,875	505,175
Crooked Creek (MS-87)	17-31	352,545						18,555	371,100	634,735	1,005,835
Goose Creek (MS-103)	17-26				DATA NOT PRESENTLY AVAILABLE						
Brown-Hill (T-9)	17c-21	475,860						966,140	1,442,000	1,140,417	2,582,417
Big Monon (T-13)	17c-20	2,528,412						1,989,988	4,518,400	2,530,318	7,048,718
Mud Creek (T-36)	17c-7	1,138,470						925,130	2,063,600	1,132,572	3,196,172
Pony Creek (Eel-12)	17b-3	411,470						16,030	427,500	355,913	783,413
Subtotal		19,773,941	6,523,444		2,688,110	430,000		5,534,559	35,511,664 [4]	23,504,972	59,016,636
West Fork White River											
Veale Creek (WFW-2)	17hl-49	612,100	395,300						1,007,400	90,152	1,097,552
Black Creek (WFW-9)	17hl-45	2,041,840	254,210		141,120			181,230	2,618,400	2,169,728	4,788,128
Splunge Creek (WFW-29)	17hla-13				DATA NOT PRESENTLY AVAILABLE						
Birch Creek (WFW-30)	17hla-11	668,800			404,300				1,073,100	1,100,386	2,173,486
Croys Creek (WFW-35)	17la-6	396,911	1,069,389						1,596,810 [5]	368,681	1,965,491
Whitelick Creek (WFW-60)	17hl-20	2,108,300	2,403,300		477,100				4,988,700	4,059,781	9,048,481
Little Walnut Creek (WFW-38)	17hla-2	777,392	749,058						1,526,450	494,301	2,020,751
Wilson Creek (WMS-5)	17h-3	65,267	563,309	15,244	34,580				678,400	169,962	848,362
Lagoon D. - W&E Canal (WFW-24,26)	17hla-14,16	599,600							599,600	542,573	1,142,173
Jordan Creek (WFW-33)	17hla-8	540,120	989,580						1,529,700	382,590	1,912,290
Deer Creek (WFW-37)	17hla-4	227,844	1,514,456						1,742,300	681,247	2,423,547
Rattlesnake Creek (WFW-43)	17hl-30	236,900	1,265,700						1,502,600	193,082	1,695,682
Bryant Creek (WFW-42)	17hl-25	80,680	329,620						410,300	77,785	488,085
Killbuck Creek (WFW-84)	17hl-3	599,300						263,800	863,100	1,389,605	2,252,705
Subtotal		8,955,054	9,533,922	15,244	1,057,100			445,030	20,136,860 [5]	11,719,873	31,856,733
East Fork White River											
Aikman Creek (EFW-2)	17h2-45	688,710						81,500	770,210	320,602	1,090,812
Lost River (EFW-10)	17h2-41	3,787,673	3,018,904	188,138					7,712,437 [6]	2,213,400	9,925,837
Upper Vernon Fork (EFW-30U)	17h2b-1	3,165,400	3,034,800	2,171,600	[2]				8,371,800	1,480,521	9,852,321
Lower Vernon Fork (EFW-30L)	17h2b-2	5,394,150	2,629,300			[3]		193,750	8,217,200	1,810,148	10,027,348
White Creek and Beatty Walker Ditch (EFW-42,43)	17h2-15	3,381,100	2,597,900					351,700	6,330,700	1,138,472	7,469,172
Lewis Creek (EFW-52)	17h2-5	859,476						396,848	1,256,324	994,896	2,251,220
Upper Big Flatrock River (EFW-54)	17h2-1	1,885,679		700,400		1,150,200		87,821	3,824,100	3,801,905	7,626,005
Delaney Creek (EFW-25)	17h2b-8	854,904	522,185				103,101		1,480,190	283,855	1,764,045
Pond Creek (EFW-27)	17h2b-7	315,540	1,054,800					25,250	1,395,590	301,640	1,697,230
Little Salt Creek (EFW-37)	17h2-33	720,500							720,500	367,316	1,087,816
Denios Creek (EFW-48)	17h2-10	243,750	961,700						1,205,450	138,145	1,343,595
Brandywine Creek (EFW-61)	17h2a-4	1,226,350						183,250	1,409,600	809,822	2,219,422
Little Blue River (EFW-63)	17h2a-3	1,301,300							1,301,300	794,342	2,095,642
Subtotal		23,824,532	13,819,589	3,060,138	[2]	1,150,200	103,101	1,320,119	43,995,401 [6]	14,455,064	58,450,465
Middle Wabash River											
Raccoon Creek (Illinois) (MS-14)	17-107	1,367,010						151,890	1,518,900	678,601	2,197,501
Snapp-Kelso (MS-19)	17-103	129,230	804,698						933,928	191,593	1,125,521
Mariah Creek (MS-21)	17-102	1,145,340	68,900					37,060	1,251,300	1,023,119	2,274,419
Turtle Creek (MS-29)	17-93	751,000	526,400				127,200		1,404,600	322,485	1,727,085
Mill Creek (MS-34)	17-87	1,423,820	1,599,240						3,023,060	840,990	3,864,050
Honey Creek (MS-42)	17-77	3,849,364	332,836						4,182,200	750,253	4,932,453
Otter Creek (MS-47)	17-71	1,263,494	2,720,740						3,984,234	959,445	4,943,679
Coal Creek (MS-55)	17-55	995,440	946,060						1,941,500	1,774,114	3,715,614

TABLE A-3. COST DATA FOR SMALL WATERSHED PROJECTS RECOMMENDED FOR EARLY ACTION INSTALLATION (CONTINUED)

Hydrologic subarea and watershed name	CNI no.	Purpose: Flood prevention	Recreation	Municipal and industrial	Water quality control	Fish and wildlife	Irrigation	Drainage	Subtotal structural cost	Land treatment cost 1/	Total project installation cost
				(dollars)							
Middle Wabash River (Cont'd)											
Big Raccoon Creek (BR-4)	17-62	[illegible]	613,100			143,400			2,435,764	2,165,595	4,601,359
Jordan Creek (V-7)	17e-7	[illegible]						171,000	795,000	744,308	1,539,308
Lye Creek (SC-14)	17f-3	[illegible]						616,500	1,211,470 2/	161,855	1,373,325
Fall Creek (MS-64)	17-51	[illegible]	354,000						374,000	7,200	381,200
Vieke Ditch (MS-12)	17-105	[illegible]						59,700	477,600	277,971	755,571
City Ditch (MS-15)	17-105	[illegible]						53,750	335,950	102,269	438,219
Sugar Creek (MS-44) 10/	17-75	[illegible]		769,700	345,300				1,777,700	1,127,891	2,905,591
Lower Shaker Prairie (MS-22)	17-101	[illegible]						23,480	313,100	169,820	482,920
Snyder Creek (Illinois) (MS-35)	17-85	[illegible]							326,800	135,998	462,798
Feather Creek (MS-101)	17-68	[illegible]	832,620						1,271,200	68,836	1,340,036
Subtotal		[illegible]	8,798,594	769,700	345,300	143,400	127,200	1,113,380	27,558,306 3/	11,502,343	39,060,649
Embarras River											
Brushy Fork (E-33)	17g-33	[illegible]							1,036,000	617,266	1,653,266
Muddy Creek (E-21)	17g-21	[illegible]	2,098,590	296,100	93,500				4,443,100	2,115,448	6,558,548
North Fork Embarras River (E-11)	17g-11	[illegible]	3,163,582	374,236	330,472				10,436,100	4,461,878	14,897,978
Crooked Creek (E-12)	17g-12	[illegible]	326,060						1,741,600	834,784	2,576,384
Muddy Creek (E-5) 10/	17g-5	[illegible]			84,200			400,790	1,742,800	991,137	2,733,937
Brushy-Birch Creek (E-3,4)	17g-3,4	[illegible]	655,429		99,690				1,872,509	826,800	2,699,309
Subtotal		[illegible]	6,243,661	670,336	607,862			400,790	21,272,109	9,847,313	31,119,422
Lower Wabash River											
Big Creek (Indiana) (MS-1)	17-125	[illegible]	1,257,316					114,741	6,002,040	2,488,393	8,490,433
Gresham Creek (MS-3)	17-121	[illegible]	1,318,000					127,100	2,244,650	166,940	2,411,590
McHenry-Hawthorne				DATA NOT PRESENTLY AVAILABLE							
Scott D.-Coffee Bayou (MS-6,8)	17-113	[illegible]	1,625,850					551,400	2,980,000	710,234	3,690,234
Bonpas Creek (MS-100) 10/	17-117	4,191,100	932,400	166,000	202,900			2,249,300	7,741,700	2,480,458	10,222,158
Subtotal		10,423,383	5,133,566	166,000	202,900			3,042,541	18,968,390	5,846,025	24,814,415
Little Wabash River											
Lick Creek (LW-2)	17j-2	[illegible]	831,800						1,246,400	240,491	1,486,891
Auxier-Big Creeks (LW-12)	17jl-12	[illegible]	189,103	874,204				1,754,464	4,950,963	2,285,078	7,236,041
Big Mound Creek (LW-14)	17jl-14	[illegible]						340,650	971,600	359,943	1,331,543
Pond Creek (LW-28,29)	17j-28	[illegible]	801,530					75,570	1,615,260 8/	529,890	2,145,150
Big Muddy Creek (LW-42)	17j-42	[illegible]	1,237,600						5,011,800	3,337,864	8,349,664
Dry Fork (LW-15)	17jl-15	[illegible]	770,600	13,000					2,664,500	736,646	3,401,146
Horse Creek (LW-18)	17jl-18	2,364,700	974,000	43,400					3,382,100	1,164,814	4,546,914
Upper Little Wabash River (LW-52)	17j-52	2,608,020		6,180	731,800				3,346,000	3,366,078	6,712,078
Fox River (LW-39)	17j-39	4,133,400	343,000	28,020	598,180				5,102,600	1,632,056	6,734,656
Salt Creek (LW-51)	17j-51	[illegible]	729,850						2,072,200	841,795	2,913,995
Subtotal		[illegible]	5,877,483	964,804	1,329,980			2,170,684	30,363,423 8/	14,494,655	44,858,078
Patoka River											
Hall-Flat Creeks (P-22)	17i-4	1,978,646	749,846	54,664	153,270				2,936,426	875,525	3,811,951
Hunley-Ell Creeks (P-20,21)	17i-6	3,110,500	1,096,500	378,600	652,400				5,238,000	1,115,028	6,353,028
Upper Patoka River Tributaries (P-32,34)	17i-3	630,800		26,600	13,100				670,500	985,287	1,655,787
Subtotal		5,719,946	1,846,346	459,864	818,770				8,844,926	2,975,840	11,820,766
TOTAL		118,097,790	57,776,605	6,106,086	7,050,022	1,723,600	230,301	14,027,103	206,651,079 9/	94,346,085	300,997,164 9/

1/ Includes forestry.
2/ No water quality control cost.
3/ No fish and wildlife cost.
4/ Includes project administration cost, PAC ($561,610).
5/ Includes PAC ($130,510).
6/ Includes PAC ($717,722).
7/ Includes PAC ($35,510).
8/ Includes PAC ($194,220).
9/ Includes PAC ($1,639,572).
10/ Final plan formulation showed the potential for both water supply and water quality storage. Storage and cost data shown are tentative and preliminary.

TABLE A–4. SUMMARY OF AVERAGE ANNUAL BENEFITS1/ AND COSTS2/ FOR SMALL WATERSHED PROJECTS PROPOSED FOR EARLY ACTION

Hydrologic subarea and watershed name	CNI no.	Hydrologic unit no	Floodplain benefited (acres)	Damage reduction: Within unit	Damage reduction: Downstream	Damage reduction: Total 3/	Other benefits: M.I.L.U. & C.L.U.	Other benefits: Drainage	Other benefits: Inc. rec	Other benefits: M&I	Other benefits: Water quality	Other benefits: Rec F&W	Other benefits: Irrigation	Other benefits: Other	Local sec	Total benefits	Annual cost	B:C ratio
				(thousands of dollars)														
Upper Wabash River																		
Clear Creek	17-9	UW-4		NO DATA AVAILABLE														
Little River 5/	17-8	UW-5	13,618	94.3		94.3 8/	23.2	32.5	11.2		161.1	96.8			46.2	465.3 8/	243.1	1.9:1
Buckeye-Hoosier	17-2,3	UW-9,20	17,900	208.4		208.4 8/	59.7	1.8	7.2		42.8	433.0		9.4	88.9	851.2 8/	615.0	1.4:1
Salamonie River	17-12	S-15	9,000	171.7		171.7 8/	31.9	8.0				160.2			42.1	413.9 8/	258.4	1.6:1
Lower Mississinewa	17a-2	M-7,15	1,600	9.4		9.4 8/						93.0			12.0	114.4 8/	82.6	1.4:1
Upper Mississinewa	17a-1	M-16,17	6,500	100.9		100.9 8/		17.2							12.1	130.2 8/	129.9	1.0:1
Sugar Creek	17-39	MS-77	940	18.0		18.0	1.6	18.6				163.1			24.9	226.2	130.2	1.7:1
Rock Creek (Cass Co)	17-33	MS-83	2,110	56.6		56.6 8/		11.0							6.1	73.7 8/	40.5	1.8:1
Burnetts Creek	17-31	MS-85	330	8.7		8.7	3.8	9.4							6.1	28.0	15.7	1.8:1
Crooked Creek	17-31	MS-87	900	23.8		23.8	1.0	5.4							3.8	34.0	23.1	1.5:1
Goose Creek	17-26	MS-103		NO DATA AVAILABLE														
Brown-Hill	17c-21	T-9	2,390	52.9		52.9	7.4	104.7							24.8	189.8	69.9	2.7:1
Big Monon	17c-20	T-13	2,890	93.0		93.0	3.1	404.8							87.6	588.5	277.0	2.1:1
House Bartee	17c-9	T-32,33	2,150	39.1		39.1	5.2	15.4							7.7	67.4	48.5	1.4:1
Mud Creek	17c-7	T-36	1,560	50.5		50.5	2.8	64.4							24.9	142.6	126.0	1.1:1
Pony Creek	17b-3	Eel-12	1,130	27.1		27.1	2.8	3.5							3.4	36.8	25.5	1.4:1
Subtotal			63,018	954.4		954.4	142.5	696.7	18.4		203.9	946.1 4/		9.4	390.6	3,362.0	2,085.4	1.6:1
West Fork White River																		
Veale Creek	17hl-49	WFW-2	1,370	22.5		22.5 8/	8.2					60.0			9.8	100.5 8/	57.1	1.8:1
Black Creek	17ji-45	WFW-9	9,310	212.3		212.3	15.2	15.5			8.5	51.6			32.5	335.6	169.4	2.0:1
Splunge Creek	17hla-14	WFW-29		NO DATA AVAILABLE														
Birch Creek	17hla-11	WFW-30	2,460	33.0		33.0	7.2				31.1				3.9	75.2	54.3	1.4:1
Croys Creek	17hla-6	WFW-35	1,350	16.6		16.6 8/	6.6					198.8			25.9	247.9 8/	122.0	2.0:1
Whitelick Creek	17hl-20	WFW-60	7,650	119.5	160.7	280.2	14.7				118.9	227.8			41.6	683.2	283.7	2.4:1
Little Walnut	17hla-2	WFW-38	4,950	57.1		57.1 8/	7.7					67.5			12.0	144.3 8/	97.6	1.5:1
Lagoon Ditch	17hla-14,16	WFW-24,26	4,540	93.9		93.9	6.9								6.9	107.7	38.4	2.8:1
Jordan Creek	17hla-8	WFW-33	1,490	19.0		19.0	5.4					102.9			14.6	141.9	93.2	1.5:1
Deer Creek	17hla-4	WFW-37	1,100	11.1	348.0	359.1	2.0					171.9			21.2	554.2	113.0	4.9:1
Rattlesnake Creek	17hl-30	WFW-43	620	12.4		12.4	2.8					134.7			17.2	167.1	95.5	1.8:1
Bryant Creek	17hl-25	WFW-52	350	6.1		6.1	0.6					51.3			6.8	64.8	28.9	2.2:1
Killbuck Creek	17hl-3	WFW-84	2,050	40.8		40.8	3.8	16.7							8.9	70.2	53.0	1.3:1
Wilson Creek	17h-3	WMS-5	850	21.6		21.6	3.0			5.5	12.9	99.0			2.3	144.3	49.8	2.9:1
Subtotal			38,090	665.9	508.7	1,174.6	84.1	32.2		5.5	171.4	1,165.5			203.6	2,836.9	1,255.9	2.3:1
East Fork White River																		
Aikman Creek	17h2-45	EFW-2	2,050	28.6		28.6 8/	7.0	9.6								45.2 8/	37.9	1.2:1
Lost River	17h2-41	EFW-10	10,550	201.2		201.2 8/	69.8			21.9		252.5		21.1	54.6	621.1 8/	455.6	1.4:1
Upper Vernon Fork	17h2b-1	EFW-30U	25,070	198.4		198.4 8/	86.3			105.7		190.0		11.9	48.9	641.2 8/	338.8	1.6:1
Lower Vernon Fork	17h2b-2	EFW-30L		249.4		249.4 8/	129.9	21.1				135.0			53.5	588.9 8/	359.7	1.6:1
White Creek-Beatty Walker	17h2-15	EFW-42,43	13,730	228.7		228.7	75.8	33.5				278.3			69.5	685.8	379.9	1.8:1
Lewis Creek	17h2-5	EFW-52	4,800	14.9		14.9 8/	9.5	88.0								112.4 8/	80.5	1.4:1
Upper Big Flatrock Creek	17h2-1,2	EFW-54	6,420	147.4		147.4	16.8	30.9		38.4		61.0			32.8	327.3	235.9	1.4:1
Delaney Creek	17h2b-8	EFW-25	2,650	60.9		60.9 8/	6.2					81.9	13.8		24.5	187.3 8/	99.4	1.9:1
Pond Creek	17h2b-7	EFW-27	1,790	45.3		45.3	16.8	4.6				135.8			21.9	224.4	93.2	2.4:1
Little Salt Creek	17h2-33	EFW-37	1,510	27.7		27.7	4.6		1.9						2.9	37.1	36.6	1.0:1
Denios Creek	17h2-10	EFW-48	1,160	45.1		45.1	4.1					192.6			25.0	266.8	94.3	2.8:1
Brandywine Creek	17h2a-4	EFW-61	5,090	139.5		139.5	16.0	3.6							12.9	172.0	87.5	2.0:1
Little Blue River	17h2a-3	EFW-63	1,220	24.9	55.2	80.1	5.0								4.0	89.1	70.8	1.3:1
Subtotal			76,040	1,412.0	660.2 6/	2,072.2 6/	447.8	191.3	1.9	166.0		1,327.1	13.8	33.0	350.5	4,603.6 6/	2,370.3	1.9:1
Middle Wabash River																		
Raccoon Creek (Illinois)	17-107	MS-14	3,710	130.9		130.9	13.0	16.0							18.3	178.2	92.7	1.9:1
Snapp-Kelso	17-103	MS-19	820	3.0		3.0 8/	1.8					75.0			2.9	82.7 8/	59.4	1.4:1
Mariah Creek	17-102	MS-21	5,010	85.9		85.9	7.8	2.1				15.0			8.4	119.2	74.3	1.6:1
Turtle Creek	17-93	MS-29	3,330	23.3		23.3 8/	13.2					45.0	10.6		18.5	111.0 8/	67.7	1.6:1
Mill Creek (Illinois)	17-87	MS-34	4,550	80.4		80.4 8/	3.6		4.3			205.6			27.0	320.9 8/	211.0	1.5:1
Honey Creek	17-77	MS-42	6,090	283.6		283.6	7.5					66.5			22.5	380.1	245.1	1.6:1
Otter Creek	17-71	MS-47	4,960	32.4		32.4 8/	36.0					337.5			6.8	412.7 8/	243.1	1.6:1
Coal Creek	17-55	MS-55	3,340	24.7	154.3	179.0	11.8					133.8			20.6	345.2	117.3	2.9:1
Big Raccoon Creek	17-62	BR-4	4,850	77.9		77.9 8/	21.2					44.2			11.4	154.7 8/	86.2	1.8:1

TABLE A 4. SUMMARY OF AVERAGE ANNUAL BENEFITS1/ AND COSTS2/ FOR SMALL WATERSHED PROJECTS PROPOSED FOR EARLY ACTION (CONTINUED)

Hydrologic subarea and watershed name	CNI no.	Hydrologic unit no.	Floodplain benefited	Damage reduction			Other benefits									Total benefits	Annual cost	B:C ratio
				Within unit	Downstream	Total3/	M.I.L.U. & C.L.U.	Drainage	Inc. rec.	M&I	Water quality	Rec. F&W	Irrigation	Other	Local sec			
			(acres)	(thousands of dollars)														
Middle Wabash River (Cont'd)																		
Jordan Creek	17e-7	V-7	3,040	37.9		37.9 8/		14.8							1.9	54.6 4/	35.2	1.5:1
Lye Creek	17f-3	SC-14	4,117	107.1		107.1 8/		18.9							13.0	139.0 6/	72.7	1.9:1
Fall Creek	17-51	MS-64	5	1.1		1.1						30.0				31.1	23.4	1.3:1
Vieke Ditch	17-105	MS-12	2,940	80.0		80.0	9.8	8.3							9.6	107.7	24.3	4.4:1
City Ditch	17-105	MS-15	2,730	62.8		62.8	5.8	4.8							6.3	79.7	20.7	3.9:1
Lower Shaker Prairie	17-101	MS-22	1,920	37.0		37.0	2.1	1.2							3.3	43.6	19.4	2.2:1
Snyder Creek	17-85	MS-35	840	29.1		29.1	1.3								2.2	32.6	18.5	1.8:1
Feather Creek	17-68	MS-101	260	26.8		26.8	0.7					100.4			14.0	141.9	80.9	1.8:1
Sugar Creek (Illinois)5/	17-75	MS-44	1,890	35.2	19.2	54.4	5.8			61.6	24.6				15.1	161.5	88.4	1.8:1
Subtotal			52,292	1,159.5	173.5	1,333.0	141.4	66.1	4.3	61.6	24.6	1,053.0	10.6		201.8	2,896.4	1,580.3	1.8:1
Embarras River																		
Brushy-Birch Creek	17g-3,4	E-3,4	6,150	107.0		107.0	11.3				8.5	115.7			22.8	265.3	120.5	2.2:1
Muddy Creek	17g-5	E-5	3,750	107.4		107.4	9.2	25.0			13.6				18.6	173.8	103.6	1.7:1
North Fork Embarras	17g-11	E-11	15,080	525.6	130.0	655.6	46.9			32.7	74.0	379.9			72.1	1,261.2	645.9	2.0:1
Crooked Creek	17g-12	E-12	2,710	23.8	38.2	62.0	28.5					67.1			17.5	175.1	104.4	1.6:1
Muddy Creek	17g-21	E-21	4,590	77.5	95.2	172.7	8.4			19.2	15.3	205.0			29.7	450.0	303.8	1.5:1
Brushy Creek	17g-33	E-33	3,030	34.7		34.7 8/		19.5							5.9	60.1 8/	56.3	1.1:1
Subtotal			35,310	876.0	263.4	1,139.4	104.3	44.5		51.9	111.4	767.7			166.6	2,385.8	1,334.5	1.8:1
Lower Wabash River																		
Big Creek	17-125	MS-1	11,210	397.4		397.4	126.7	10.9				138.5				673.5	289.5	2.3:1
Gresham Creek	17-121	MS-3	3,050	45.6		45.6 8/	18.3	7.1				222.0			30.1	323.1 8/	161.0	2.0:1
Scott Ditch-Coffee Bayou	17-113	MS-6,8	7,690	98.8		98.8		51.7				321.1			67.7	539.3	212.6	2.5:2
Bompas Creek 5/	17-117	MS-100	8,250	238.2		238.2	25.1	78.6		12.7	15.5	193.7			78.2	642.0	471.3	1.4:1
McHenry Hawthorne							DATA	NOT AVAILABLE										
Subtotal			30,200	780.0		780.0	170.1	148.3		12.7	15.5	875.3			176.0	2,177.9	1,134.4	1.9:1
Little Wabash River																		
Lick Creek	17j-2	LW-2	1,430	37.5		37.5	2.5					130.8			18.2	189.0	84.5	2.2:1
Auxier-Big Creek	17j-12	LW-12	10,580	103.0		103.0 8/	57.7	57.7		46.1		22.1		11.9	49.7	348.2 8/	238.1	1.5:1
Big Mound	17j-14	LW-14	2,250	71.1		71.1	4.0	6.3							7.1	88.5	56.1	1.6:1
Pond Creek	17j-28,29	LW-28,29	4,730	21.6		21.6 8/	11.4	11.4				71.9			15.2	131.5 8/	107.0	1.2:1
Big Muddy Creek	17j-42	LW-42	9,670	157.0		157.0	34.4					303.4			56.3	551.1	304.5	1.8:1
Dry Fork	17j-15	LW-15	4,040	123.2		123.2	8.0			15.2		154.4			210.6	511.4	160.7	3.2:1
Horse Creek	17j-18	LW-18	4,410	116.9		116.9	10.8			25.3		177.7			32.9	363.6	206.1	1.8:1
Upper Little Wabash	17j-52	LW-52	5,210	150.7		150.7	19.4			4.1	60.6				20.0	254.8	175.1	1.5:1
Fox River	17j-39	LW-39	7,660	116.3		116.3	54.2			10.4	57.7	132.2			39.0	409.8	304.3	1.3:1
Salt Creek	17j-51	LW-51	1,920	44.1		44.1	6.9					93.0			16.2	160.2	121.2	1.3:1
Subtotal			51,900	941.4	356.4	1,297.8 7/	209.3	75.4		101.1	118.3	1,085.5		11.9	465.2	3,364.5 7/	1,757.6	1.9:1
Patoka River																		
Hall-Flat Creek	17i-4	P-22	3,100	98.8	7.1	105.9 8/	31.3			2.2	6.3	75.0			21.4	242.1 8/	186.4	1.3:1
Hunley EP Creek	17i-6	P-20,21	6,260	92.7 8/	7.2	99.9 8/	43.7			55.3	57.0	126.0			40.7	422.6 8/	308.4	1.4:1
Upper Patoka Tribs	17i-3	P-32,34	990	19.0	11.2	30.2	3.5			1.4	0.7				2.6	38.4	30.0	1.2:1
Subtotal			10,350	210.5	25.5	236.0	78.5			58.9	64.0	201.0			64.7	703.1	524.8	1.3:1
TOTAL			357,200	6,999.7	1,987.7	8,987.4	1,378.0	1,254.5	24.6	457.7	709.1	7,421.2 4/	24.4	54.3	2,019.0	22,330.2	12,043.2	1.9:1

1/ Price base: Adjusted normalized (April 1966).
2/ Price base: Installation costs - 1968, O.M&R - Adjusted normalized. Amortization period - 100 years at 4-7/8% interest rate.
3/ Includes future growth benefits.
4/ Does not include $15,000 recreation benefits on Goose Creek.
5/ Final plan formulation showed the potential for both water supply and water quality storage. Storage and cost data shown are tentative and preliminary.
6/ Includes $605,000 as yet not allocated to individual hydrologic units.
7/ Includes $356,400 as yet not allocated to individual hydrologic units.
8/ Does not include future growth.

TABLE A–5. PHYSICAL DATA IN SMALL WATERSHED PROJECTS IN THE LONG RANGE PROGRAM

Hydrologic subarea and watershed name		CNI no	Purpose 1/	Project area	No. of strs.	Drainage area controlled	Storage: Flood prevention: Sediment	Storage: Flood prevention: Detention	Storage: Other uses	Storage: Total storage	Area: Permanent pool	Area: Top of dam	Additional storage capacity available	Maximum potential surface area	Channel improvement	Annual visitor days provided
				(sq mi)		(sq mi)	(ac ft)	(ac ft)	(ac ft)	(ac ft)	(ac)	(ac)	(ac ft)	(acres)	(mile)	
Upper Wabash River																
S-13	Scuffle Creek	17-14	FP,D	14.1											7.2	
EEL-13	Eel River	17b-1	FP	380.7	1	5.0	370	890		1,260	30			30	122.0	
T-10	Timmons Ditch	17c-19	FP,D	10.7											9.9	
T-16	Ackerman Ditch	17c-18	FP,D	9.1											6.3	
T-25	Quigley Marsh Ditch	17c-11	FP,D	14.0											6.0	
T-31	Fell-Taylor Ditch	17c-9	FP,D	4.4											3.5	
T-34	Chapman Creek	17c-8	FP,D	3.4											3.0	
W-4	South Fork Wildcat Creek	17d-2	FP,D	242.0											16.8	
MS-78	Deer Creek	17-36	FP,D	338.4											95.5	
MS-80	Pleasant Run Creek	17-34	FP,D	12.6											2.7	
MS-82	Rattlesnake Creek	17-34	FP,D	29.3											13.7	
	Subtotal			1,058.7	1	5.0	370	890		1,260	30			30	286.6	
West Fork White River																
15	Doans Creek	17hl-40	FP,R	26.6	2	10.6	900	2,220	3,200	6,320	360	670	3,990	180		110,700
23	Lick Creek	17hla-17	FP,R	55.2	6	31.3	2,360	5,890	5,500	13,750	600	1,490	38,670	2,450		85,800
25	Pond Creek	17hla-15	FP	4.4											2.7	
31	Six Mile Creek	17hla-10	FP,R	26.8	5	11.5	950	2,280	1,660	4,890	255	700	13,710	1,030	3.2	56,250
32&34	Hog McIntyre	17hla-7,9	FP,R	17.4	2	6.4	680	1,370	2,110	4,160	310	580		220		100,950
40	Fish Creek	17hl-32	FP,R	58.2	6	31.5	2,140	6,680	17,450	26,270	1,015	1,480	10,040	1,635		124,900
55	Burkhart Creek	17hl-24	FP,R	7.1	1	2.3	150	390	2,930	3,470	130	170	1,030	160		43,900
59	Clear Creek	17hl-19	FP,R	23.0	1	2.3	120	430	3,000	3,550	200	270	790	230		108,000
82	Pipe Creek 2/	17hl-5					DATA NOT PRESENTLY AVAILABLE									
	Subtotal			218.7	23	95.9	7,300	19,260	35,850	62,410	2,870	5,360	68,230	5,905	5.9	680,500
East Fork White River																
7&9	Sugar and Slate Creek	17h2-40	FP,R	36.9	6	13.4	1,320	2,740	4,100	8,160	430	1,210	14,250	870		112,900
15	Sulphur Creek	17h2-34	FP,R	169.7	1	11.2	600	2,310	4,800	7,710	280	490	6,300	330		109,800
18	Gutherie	17h2-24	FP,R,M&I	96.6	3	36.7	2,270	15,440	3,870	21,580	400	1,070	22,560	1,100		110,000
23	Buffalo Creek	17h2-20	FP,R	16.6	2	6.7	360	1,240	6,580	8,180	310	450	3,310	460		60,100
40	McHargue Ditch	17h2-17	FP,D	8.4	1	1.2	40	180		220	20	40	1,270	90	2.5	
44	John Thompson Ditch	17h2-13	FP	11.8											7.3	
50	Big Slough	17h2-6	FP	15.9											9.4	
59	Youngs Creek	17h2-6	FP	108.3	2	5.3	340	920		1,260	55	280	670	250	12.6	
67	Bear Creek	17h2-44	FP,R	6.5	1	3.2	340	730	2,340	3,410	290	450		290		110,000
	Subtotal			470.7	16	77.7	5,270	23,560	21,690	50,520	1,785	3,990	48,360	3,390	31.8	502,800
Middle Wabash River																
MS-11	Crawfish Creek	17-110	FP,D	34.5											15.3	
MS-32	Turman Creek	17-91	FP	90.0	2	34.5	2,210	7,300		9,510				380		
MS-33	Raccoon Creek (Illinois)	17-88	FP,R	42.4	2	15.6	1,000	4,220	4,440	9,660	340	610	7,930	880	4.2	85,800
MS-38	Big Creek (Illinois)	17-82	FP,R	108.3	4	56.3	4,040	14,010	7,940	25,990	1,000	2,080	20,600	1,850		196,100
MS-43	Clear Creek (Illinois)	17-76	FP,R	43.3	2	28.8	1,590	7,190	11,520	20,300	850	1,560	4,650	1,120		118,250
MS-45	Lost Creek	17-73	FP	26.7	1	4.1	440	1,000		1,440	45	200		45	4.4	
[illegible]	[illegible]	17-68	FP,R	24.7	2	15.2	970	2,970	4,010	7,950	330	730	4,120	570		109,450

TABLE A–5. PHYSICAL DATA IN SMALL WATERSHED PROJECTS IN THE LONG RANGE PROGRAM (CONTINUED)

Hydrologic subarea and watershed name		CNI no.	Purpose 1/	Project area (sq mi)	No. of strs	Drainage area controlled (sq mi)	Storage: Flood Prevention Sediment (ac ft)	Storage: Flood Prevention Detention (ac ft)	Storage: Other uses (ac ft)	Storage: Total storage (ac ft)	Area: Permanent pool (ac)	Area: Top of dam (ac)	Additional storage capacity available (ac ft)	Maximum potential surface area (acres)	Channel improvement (mile)	Annual visitor days provided
Middle Wabash River (Cont'd)																
MS-65	Big Shawnee Creek	17-52	FP,D	64.4											24.1	
V-3	Cole Branch	17e-3	FP	16.0	1	12.8	410	2,680		3,090	50	260	680	110		
V-11	Stony Creek (Illinois)	17e-11	FP, D	72.0											16.5	
SC-4	Sugar Mill	17f-10	FP, R	92.3	3	33.9	1,940	6,790	1,700	10,430	230	690	1,240	370		82,300
SC-13	Little Sugar Creek	17f-5	FP, D	93.7											8.3	
	Subtotal			708.3	17	201.2	12,600	46,160	29,610	88,370	2,845	6,130	39,220	5,325	72.8	591,900
Embarras River																
2, 36, 37	Otter-Beaver-Allison	17g-2,37,36	FP,D	82.0											38.2	
7	Honey Creek	17g-7	FP,R	38.0	2	19.3	1,130	4,280	720	6,130	320	850	1,240	460	7.6	68,800
20	Range Creek	17g-20	FP,R	58.5	3	29.6	1,700	7,510	4,320	13,530	585	1,210	1,280	710		86,000
23	Hurricane Creek	17g-23	FP	57.1	2	42.2	1,960	10,110		12,070	170	1,420	3,130	510		
	Subtotal			235.6	7	91.1	4,790	21,900	5,040	31,730	1,075	3,480	5,650	1,680	45.8	154,800
Lower Wabash River																
MS-4	Black River	17-120	FP, R	100.2	4	5.5	600	1,130	1,260	2,990	225	1,200	6,410	775	26.8	82,400
MS-5	French Creek	17-118	FP,R	21.2	2	7.7	650	2,330	5,630	8,610	600	1,000	3,940	840	7.2	114,300
	Subtotal			121.4	6	13.2	1,250	3,460	6,890	11,600	825	2,200	10,350	1,615	34.0	196,700
Little Wabash River																
6	Limekiln Creek	17jl-6	FP,D	13.1											4.8	
8	Lost Creek	17jl-8	FP	30.8	2	5.7	520	980		1,500	130	330				
9	Beaver Creek	17jl-9	FP	24.6											7.9	
10	Prairie Creek	17jl-10	FP,D	13.6											4.9	
11	Nameless Creek	17jl-11	FP,M&I	6.0	1	3.0	250	800	690	1,740	130	300	1,730	240		
21	Brush Creek	17jl-21	FP	57.4	2	19.9	1,060	6,240		7,300	150	1,030	5,720	620	10.2	
24	Elliott Creek	17j-24	FP	13.1											2.3	
27	Big Creek	17j-27	FP	34.3											18.8	
34	Elm River	17j-34	FP,R	276.7	13	181.8	11,550	58,060	4,790	74,400	2,940	13,740	14,330	4,260	30.8	218,400
44	Panther Creek	17j-44	FP	30.3	2	9.8	630	1,700		2,330	120	350	1,340	240	7.5	
45	Crooked Creek	17j-45	FP	46.6	1	26.1	1,670	7,210		8,880	230	770		230		
46	Dismal Creek	17j-46	FP	52.0	1	32.2	2,060	9,570		11,630	280	950	9,540	790		
50	Bishop Creek	17j-50	FP,M&I	66.6	2	33.5	2,140	8,150	410	10,700	330	1,180		330		
	Subtotal			665.1	24	312.0	19,880	92,710	5,890	118,480	4,310	18,650	32,660	6,710	87.2	218,400
Patoka River																
12	Flat Creek	17i-12	FP, M&I	13.5	1	4.7	250	1,150	300	1,700	110	300		110		
15	Cup Creek	17i-9	FP,R,M&I	18.2	2	4.5	240	600	1,500	2,340	140	220	4,440	360	3.3	42,000
	Subtotal			31.7	3	9.2	490	1,750	1,800	4,040	250	520	4,440	470	3.3	42,000
TOTAL				3,510.2	97	805.3	51,950	209,690	106,770	368,410	13,990	40,330	208,910	25,125	567.4	2,337,100

1/ FP – Flood Prevention, D – Drainage, R – Recreation, M&I – Municipal and Industrial Water.

2/ Final plan formulation indicates water quality control for Alexandria. Pipe Creek project could be developed in Early Action period if needed.

WATER QUALITY CRITERIA ADOPTED BY BASIN STATES

OHIO

Applies to the Wabash River and its tributaries in Ohio.

Minimum conditions applicable to all waters at all places and at all times:

1. Free from substances attributable to municipal, industrial, or other discharges, or agricultural practices that will settle to form putrescent or otherwise objectionable sludge deposits.

2. Free from floating debris, oil, scum, and other floating materials attributable to municipal, industrial, or other discharges, or agricultural practices in amounts sufficient to be unslightly or deleterious.

3. Free from materials attributable to municipal, industrial, or other discharges, or agricultural practices producing color, odor, or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial, or other discharges, or agricultural practices in concentrations or combinations which are toxic or harmful to human, animal, plant or aquatic life.

For Public Water Supply

1. Bacteria: Coliform group not to exceed 5,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than five percent of such samples.

2. Threshold-odor Number: Not to exceed 24 (at 60°C) as a daily average.

3. Dissolved Solids: Not to exceed 500 mg/l as a monthly average value, nor exceed 750 mg/l at any time.

4. Radioactive Substances: Gross beta activity not to exceed 1,000 picocuries per liter (pC/l), nor shall activity from dissolved strontium-90 exceed 10 pC/l, nor shall activity from dissolved alpha emitters exceed 3 pC/l.

5. Chemical Constituents: Not to exceed the following specified concentrations at any time:

Constituents	Concentration (mg/l)
Arsenic	0.05
Barium	1.00
Cadmium	0.01
Chromium (Hexavalent)	0.05
Cyanide	0.025
Fluoride	1.00
Lead	0.05
Selenium	0.01
Silver	0.05

For Industrial Water Supply

1. Dissolved Oxygen: Not less than 2.0 mg/l as a daily average value, nor less than 1.0 mg/l at any time.

2. pH: Not less than 5.0 or greater than 9.0 at any time.

3. Temperature: Not to exceed 95°F at any time.

4. Dissolved Solids: Not to exceed 750 mg/l as a monthly average value nor exceed 1,000 mg/l at any time.

For Aquatic Life

For the evaluation of conditions for the maintenance of a well balanced, warm water fish population at any point in the stream except for areas necessary for the admixture of effluents with stream water.

1. Dissolved Oxygen: Not less than an average of 5.0 mg/l per calendar day and not less than 4.0 mg/l at any time.

2. pH: (a) No values below 6.0 nor above 8.5; (b) Daily fluctuations which exceed the range of pH 6.0 to pH 8.5 and are correlated with photosynthesis activity may be tolerated.

3. Temperature: (a) No abnormal temperature changes that may affect aquatic life unless caused by natural conditions; (b) The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained; (c) Maximum temperature rise at any time or place above natural temperatures shall not exceed 5°F. In addition, the water temperature shall not exceed the maximum limits in the following table.

All waters except the Ohio River

Month	Max. Temp.
January	50
February	50
March	60
April	70
May	80
June	90
July	90
August	90

WATER QUALITY CRITERIA ADOPTED BY BASIN STATES (CONTINUED)

Month	Max Temp
September	90
October	78
November	70
December	57

4. Toxic Substances: Not to exceed one-tenth of the 48-hour median tolerance limit, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

5. Taste and Odor: No standard adopted.

For the evaluation of conditions for the maintenance of biological growth and for permitting the passage of fish through the water, at any point in the stream, except for areas necessary for the admixture of effluents with stream water.

1. Dissolved Oxygen: Not less than 3.0 mg/l as a daily average value, nor less than 2.0 mg/l at any time.

2. pH: Not less than 6.0 nor greater than 8.5 at any time.

3. Temperature: Not to exceed 95°F at any time.

4. Toxic Substances: Not to exceed one-tenth of the 48 hour median tolerance limit, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

For Recreation

1. All Recreational Uses:

Bacteria: The fecal coliform content (either MPN or MF count) not to exceed 200 per 100 ml as a monthly geometric mean based on not less than five samples per month; nor exceed 400 per 100 ml in more than ten percent of all samples taken during a month.

For Agriculture and Stock Water

Criteria are the same as Minimum Conditions above.

INDIANA

Applies to all waters of the Wabash in Indiana.

Minimum conditions applicable to all waters at all places and at all times:

1. Free from substances attributable to municipal, industrial, agricultural, or other discharges that will settle to form putrescent or otherwise objectionable deposits.

2. Free from floating debris, oil, scum, and other floating materials attributable to municipal, industrial, agricultural, or other discharges in amounts sufficient to be unsightly or deleterious.

3. Free from materials attributable to municipal, industrial, agricultural or other discharges producing color, odor, or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial, agricultural or other discharges in concentrations or combinations which are toxic or harmful to human, animal, plant, or aquatic life.

For Public Water Supply and Food Processing Industry

1. Bacteria: Coliform group not to exceed 5,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than five percent of such samples.

2. Threshold-Odor Number: Taste and odor producing substances, other than naturally occurring, shall not interfere with the production of finished water by conventional treatment consisting of coagulation, sedimentation, filtration, and chlorination. The threshold-odor number of the finished water must be three or less.

3. Dissolved Solids: Other than from naturally occurring sources not to exceed 500 mg/l as a monthly average value, nor exceed 750 mg/l at any time. Values of specific conductance of 800 and 1,200 microhmos/cm (at 25°C) may be considered equivalent to dissolved solids concentrations of 500 and 750 mg/l.

4. Radioactive Substances: Water supplies shall be approved without further consideration of other sources of radioactivity intake of Radium-226 and Strontium-90 when the water contains these substances in amounts not exceeding three and ten picocuries per liter, respectively. In the known absence of Strontium-90 and alpha emitters, the water supply is acceptable when the gross beta concentrations do not exceed 1,000 picocuries per liter.

5. Chemical Constituents: Not to exceed the following specific concentrations at any time:

Constituent	Concentration (mg/l)
Arsenic	0.05
Barium	1.00
Cadmium	0.01
Chromium (Hexavalent)	0.05
Cyanide	0.025

WATER QUALITY CRITERIA ADOPTED BY BASIN STATES (CONTINUED)

Constituents	Concentration
Fluoride	1.00
Lead	0.05
Selenium	0.01
Silver	0.05

For Industrial Water Supply

1. Dissolved Oxygen: Not less than 2.0 mg/l as a daily average value, nor less than 1.0 mg/l at any time.

2. pH: Not less than 5.0 nor greater than 9.0 at any time.

3. Temperature: Not to exceed 95°F at any time.

4. Dissolved Solids: Other than from naturally occurring sources not to exceed 750 mg/l as a monthly average value, nor exceed 1,000 mg/l at any time. Values of specific conductance of 1,200 and 1,600 microhmos/cm (at 25°C) may be considered equivalent to dissolved solids concentrations of 750 and 1,000 mg/l.

For Aquatic Life

For evaluation of conditions for the maintenance of a well balanced, warm water fish population, applicable at any point in the stream except for areas immediately adjacent to outfalls. In such areas cognizance will be given to opportunities for the admixture of waste effluents with river water.

1. Dissolved Oxygen: Concentrations shall average at least 5.0 mg/l per calendar day and shall not be less than 4.0 mg/l at any time outside the mixing zone.

2. pH: No values below 6.0 nor above 8.5, except daily fluctuations which exceed pH 8.5 and are correlated with photosynthesic activity, may be tolerated. However, any sudden drop below 6.0 or sudden rise above 8.5 not related to photosynthesis indicates abnormal conditions which should be investigates immediately.

3. Temperature: (a) No abnormal temperature changes that may affect aquatic life unless caused by natural conditions; (b) The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained; (c) Maximum temperature rise at any time or place above natural temperatures shall not exceed 5°F. In addition, the water temperature shall not exceed the maximum limits indicated in the following table:

(Applicable to Wabash River Basin)

Month	Max. Temp.
January	50
February	50
March	60
April	70
May	80
June	90
July	90
August	90
September	90
October	78
November	70
December	57

4. Toxic Substances: Not to exceed one-tenth of the 96 hour median tolerance limit obtained from continuous flow bioassays where the dilution water and toxicant are continuously renewed, except that other application factors may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agencies.

5. Taste and Odor: There shall be no substances which impart unpalatable flavor to food fish, or result in noticeable offensive odors in the vicinity of the water.

6. Cold Water Species:

(a) In trout and salmon streams where natural reproduction is to be protected, no heat shall be added.

(b) In put and take streams, temperature shall not exceed 65°F, or a 5°F rise above natural, whichever is less.

(c) In waters designated for put and take trout fishing, dissolved oxygen concentrations may not be less than 6.0 mg/l at any time or any place. Spawning areas, during the spawning season, shall be protected by a minimum DO concentration of 7.0 mg/l.

For Recreation

1. Whole Body Contact: Fecal coliform content (either MPN or MF count) shall not exceed 200 per 100 ml as a monthly geometric mean based on not less than five samples per month, nor exceed 400 per 100 ml in more than ten percent of all samples taken during a month. The months of April through October, inclusive, are designated as the recreation season.

2. Partial Body Contact: Fecal coliform content (either MPN or MF count) shall not exceed a geometric mean of 1,000 per 100 ml, nor exceed 2,000 per 100 ml in more than ten percent of the samples.

WATER QUALITY CRITERIA ADOPTED BY BASIN STATES (CONTINUED)

For Agriculture and Stock Water

Criteria are the same as Minimum Conditions above.

ILLINOIS – INTERSTATE

Applies to Wabash River and streams crossing into Indiana: Clear Creek, Sugar Creek, Brouilletts Creek, Little Vermilion River and Vermilion River.

Minimum conditions to apply to all waters at all places and at all times:

1. Free from substances attributable to municipal, industrial, or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits; or which will form bottom deposits that may be detrimental to bottom biota (such as coal fines, limestone dust, fly ash, etc.)

2. Free from floating debris, oil, scum, and other floating materials attributable to municipal, industrial, or other discharges in amounts sufficient to be unsightly or deleterious. Oils, grease and floating solids shall be reduced to a level such that they will not create fire hazards, coal hulls of watercraft, injure fish or wildlife or their habitat, and will not adversely affect public or private recreational development or other legitimate shoreline developments or uses.

3. Free from materials attributable to municipal, industrial or other discharges producing color, odor, or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial, or other discharges in concentrations or combinations which are toxic or harmful to human, animal, plant, or aquatic life.

For Public Water Supply and Food Processing Industry

q

1. Bacteria: Coliform group not to exceed 5,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than five percent of such samples.

2. Threshold-Odor Number: No standard given.

3. Dissolved Solids: Not to exceed 500 mg/l as a monthly average value, nor exceed 750 mg/l at any time.

4. Radioactive Substances: Gross beta activity not to exceed 1,000 picocuries per liter (pCi/l) nor shall activity from dissolved alpha emitters exceed 3 pCi/l.

5. Chemical Constituents: Not to exceed the following specified concentrations at any time:

Constituent	Concentration (mg/l)
Arsenic	0.05
Barium	1.00
Cadmium	0.01
Chromium (Hexavalent)	0.05
Cyanide	0.025
Fluoride	1.00
Lead	0.05
Selenium	0.01
Silver	0.05

For Industrial Water Supply

1. Dissolved Oxygen: Not less than 3.0 mg/l during at least 16 hours of any 24 hour period, not less than 2.0 mg/l at any time.

2. pH: Not less than 6.0 nor greater than 9.0 at any time.

3. Temperature: Not to exceed 90°F at any time.

4. Dissolved Solids: Not to exceed 750 mg/l as a monthly average value, nor exceed 1,000 mg/l at any time. For Wabash River water, values of specific conductance of 1,200 and 1,600 microhmos/cm (at 25°C) may be considered equivalent to dissolved solids concentrations of 750 and 1,000 mg/l.

For Aquatic Life

For evaluation of conditions for the maintenance of a well balanced, warm water fish population, applicable at any point in the stream except for areas immediately adjacent to outfalls. In such areas cognizance will be given to opportunities for the admixture of waste effluents with river water.

1. Dissolved Oxygen: Not less than 5.0 mg/l during at least 16 hours of any 24 hour period, nor less than 4.0 mg/l at any time.

2. pH: No values below 6.0 nor above 9.0 and daily average (or median) values preferably between 6.5 and 8.5

3. Temperature: Not to exceed 90°F at any time during the months of April through November, and not to exceed 60°F at anytime during the months of December to April.

4. Toxic Substances: Not to exceed one tenth of the 48 hour median for fish, tolerance limit, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

5. Taste and Odor: Waters shall be free of substances from other than natural origin which will result in

impairment of taste, odor, or other factors which would reduce the acceptability of fishes for human consumption.

For Recreation

1. Primary contact (prolonged and intimate contact with the water):

Bacteria: As determined by multiple-tube fermentation or membrane filter procedures, and based on a minimum of not less than five samples taken over not more than a 30 day period, the fecal coliform content of primary contact recreation waters shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of total samples during any 30 day period exceed 400/100 ml.

2. Secondary contact (incidental or accidental contact with water):

Bacteria: The fecal coliform content of secondary contact recreation waters, as determined by either multiple-tube fermentation or membrane filter techniques, shall not exceed a geometric mean of 1,000/100 ml, nor shall they equal or exceed 2,000/100 ml in more than ten percent of such samples.

Compliance of bacteriological standards for recreation required during the recreation season of April through October, inclusive.

For Agriculture and Stock Water

No specific standards.

ILLINOIS – INTRASTATE

Applies to Wabash River tributaries wholly in Illinois: Embarras River, Bonpas Creek, Little Wabash River, and minor tributaries to the Wabash River in Illinois.

Minimum conditions to apply to all waters at all places and at all times:

1. Free from substances attributable to municipal, industrial, or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits; or which will form bottom deposits that may be detrimental to bottom biota (such as coal fines, limestone dust, fly ash, etc.)

2. Free from floating debris, oil, scum, and other floating materials attributable to municipal, industrial, or other discharges in amounts sufficient to be unsightly or deleterious. Oils, grease and floating solids shall be reduced to a point such that they will not create fire hazards, coat hulls of watercraft, injure fish or wildlife or their habitat, or will adversely affect public or private recreational development or other legitimate shoreline developments or uses.

3. Free from manterials attributable to municipal, industrial or other discharges producing color, odor, or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial, or other dischages in concentrations or combinations which are toxic or harmful to human, animal, plant or aquatic life.

For Public Water Supply and Food Processing Industry

1. Bacteria: Coliform group not to exceed 5,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than five percent of such samples.

2. Threshold-Odor Number: No standard given.

3. Dissolved Solids: Not to exceed 500 mg/l as a monthly average value, nor exceed 750 mg/l at any time. Values of specific conductance of 750 and 1,025 microhmos/cm (at 25°C) may be considered equivalent to dissolved concentration of 500 to 750 mg/l.

4. Radioactive Substances: Gross beta activity in the known absence of Strontium-90 and alpha emitters not to exceed 1,000 picocuries per liter at any time. "Absence of" is defined as not more than ten picocuries of Strontium-90 and three picocuries of alpha radiation.

5. Chemical Constituents: Not to exceed the following specific concentrations at any time:

Constituent	Concentration (mg/l)
Arsenic	0.05
Acidity (Total)	0.00
Ammonia Nitrogen (N)	2.50
Barium	1.0
Cadmium	0.01
CCE (Carbon Chloroform Extract)	0.2
Chloride	150
Chromium (Hexavalent)	0.05
Chromium (Trivalent)	1.00
Copper	1.0
Cyanide	0.025
Fluoride	1.00
Iron (Total)	0.3
Lead	0.05
MBAS	0.5
Nitrate (As NO_3)	45

WATER QUALITY CRITERIA ADOPTED BY BASIN STATES (CONTINUED)

Constituent	Concentration (mg/l)
Oil - Substantially free of visible floating oil	
pH	6.0–9.0 SU
Phenols	0.02
Phosphate	4.0
Selenium	0.01
Silver	0.05
Sulfate	200
Temperature	90°F
Zinc	5.0

For Industrial Water Supply

No designated standard.

For Aquatic Life

For evaluation of conditions for the maintenance of a well balanced, warm water fish population, applicable at any point in the stream except for areas immediately adjacent to outfalls. In such areas cognizance will be given to opportunities for the admixture of waste effluents with river water. Specific streams or headwater sections of streams may be declared to be unsuitable for sustaining fish and aquatic life.

1. Dissolved Oxygen: Not less than 5.0 mg/l during at least sixteen hours of any 24 hour period, nor less than 4.0 mg/l at any time.

2. pH: No values below 6.0 nor above 9.0, and daily average (or median) values preferably between 6.5 and 8.5.

3. Temperature: Not to exceed 90°F at any time during the months of April through November, and not to exceed 60°F at any time during the months of December to April.

4. Toxic Substances: Not to exceed one-tenth of the 48 hour median tolerance limit, for fish, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

5. Taste and Odor: No standard adopted.

For Recreation

1. Primary contact (prolonged and intimate contact with the water):

Bacteria: As determined by multiple tube fermentation or membrane filter procedures, and based on a minimum of not less than five samples taken over not more than a 30 day period, the fecal coliform content of primary contact recreation waters shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of total samples during any 30 day period exceed 400/100 ml.

2. Secondary contact (incidental or accidental contact with water):

Bacteria: The fecal coliform content of secondary contact recreation waters, as determined by either multiple tube fermentation or membrane filter techniques, shall not exceed a geometric mean of 1,000/100 ml, nor shall they equal or exceed 2,000/100 ml in more than ten percent of such samples.

To apply at any point in water designated to be used for recreational purposes:

Bacteria: Coliform group not to exceed 5,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than five percent of such samples.

Compliance of bacteriological standards for recreation required during the recreation season of April through October, inclusive.

For Agriculture or Stock Watering

1. Free from substances attributable to municipal, industrial, or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits.

2. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial, or other discharges in amounts sufficient to be unsightly or deleterious.

3. Free from materials attributable to municipal, industrial, or other discharges producing color, odor, or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial, or other discharges in concentrations or combinations which are toxic or harmful to human, animal, plant, or aquatic life.

WABASH RIVER BASIN

COMPREHENSIVE STUDY

MAIN REPORT

ATTACHMENT B

AGENCY COMMENTS

WABASH RIVER COORDINATING COMMITTEE

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Atkinson Square-West, 5610 Crawfordsville Road, Indianapolis, Ind. 46224

June 21, 1971

Colonel John T. Rhett, Chairman
Wabash River Basin Comprehensive Study
Coordinating Committee
Louisville District, Corps of Engineers
P.O. Box 59
Louisville, Kentucky 40201

We have completed our review of the final field level review draft of the Wabash River Basin Comprehensive Study Main Report and supporting thirteen appendices. Our comments on the main report and thirteen appendicies have been previously transmitted to you.

We are in general agreement with the main report and the recommendations therein by the coordinating committee.

We are not in accord with the parochial objective philosophy evidenced in the Recreation, Fish and Wildlife and Environmental Appendix I. The Water Resource Council guidelines call for conducting River Basin studies on a multi-objective basis.

The late completion of this appendix did not provide sufficient time for the mutual exchange of ideas and viewpoints that would have helped make the appendix more multi-objective and comprehensive in nature.

We are appreciative of the excellent cooperation and leadership provided by you and your staff in the comprehensive study and report. It has also been a pleasure for us to work with the other members of the coordinating committee.

Sincerely yours,

Thomas B. Evans

Thomas B. Evans
Coordinating Committee Representative
(U. S. Department of Agriculture)

Economic Research Service
Forest Service
Soil Conservation Service

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION V
433 WEST VAN BUREN STREET, ROOM 712
CHICAGO, ILLINOIS 60607

PUBLIC HEALTH SERVICE

June 22, 1971

Colonel John T. Rhett, District Engineer
Chairman, Wabash River Coordinating Committee
Department of the Army
Louisville District, Corps of Engineers
P. O. Box 59
Louisville, Kentucky 40201

Dear Colonel Rhett:

We have completed our review of the final field level review draft of the Wabash River Basin Comprehensive Study report and supporting appendices. Our comments have been previously transmitted to you and/or other agencies.

Our review and general agreement with the comprehensive plan recommended by the Wabash Coordinating Committee is made at field level and is not to be construed as a commitment on the part of the Department of Health, Education, and Welfare.

Sincerely yours,

Donald W. Marshall

Donald W. Marshall, P.E.
Sanitary Engineer Director

cc: Dr. Raymond T. Moore
Special Assistant to the Surgeon General
OS-DHEW

Miss Marian Mlay
Acting Regional Director
Chicago Regional Office

United States Department of the Interior
OFFICE OF THE SECRETARY
UPPER-MISSISSIPPI WESTERN GREAT LAKES AREA
2510 DEMPSTER STREET
DES PLAINES, ILLINOIS 60016

June 22, 1971

Colonel John T. Rhett, Jr.
Chairman, Wabash River Basin
Coordinating Committee
U. S. Army Corps of Engineers
P. O. Box 59
Louisville, Kentucky 40201

Dear Colonel Rhett:

The Department of the Interior is in general agreement with the framework plan of comprehensive development recommended by the Wabash River Basin Coordinating Committee. While we have reservations as to the possible environmental effects of some of the elements, we recognize that an opportunity will be available for further comments when detailed plans are completed.

Therefore, we accept the concept as presented in the Main Report of the Committee.

Very truly yours,

Burton H. Atwood

Burton H. Atwood
Field Representative
North Central Region

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION FOUR

150 West Market Street
Indianapolis, Indiana

June 23, 1971

IN REPLY REFER TO: 4-12.3

Colonel John T. Rhett, Chairman
Wabash River Basin Comprehensive Study
Coordinating Committee
Louisville District, Corps of Engineers
P. O. Box 59
Louisville, Kentucky 40201

Dear Colonel Rhett:

We have completed our review of the final field level review draft of the Wabash River Basin Comprehensive Study Summary Report and supporting appendices. Our comments on the main report and the thirteen appendices have been previously transmitted to you and/or author agencies. This letter is to indicate the Department of Transportation's general agreement with the Comprehensive Plan recommended by the Wabash Coordinating Committee.

Sincerely,

William D. Richardson

William D. Richardson
Coordinating Committee Representative
Department of Transportation

ENVIRONMENTAL PROTECTION AGENCY
Office of Water Programs, Region V
33 East Congress Parkway
Chicago, Illinois 60605

Your Reference ORLPD-P

JUN 24 1971

Colonel John T. Rhett, Chairman
Wabash River Basin Study
Coordinating Committee
Louisville District, Corps of Engineers
Department of the Army
P. O. Box 59
Louisville, Kentucky 40201

Dear Colonel Rhett:

We have completed our review of the final field level review draft of the Wabash River Basin Comprehensive Study Summary Report and supporting appendices. Our comments on the main report and the 12 appendices have been previously transmitted to you.

This letter is to indicate our general agreement with the Comprehensive Plan recommended by the Wabash Coordinating Committee; however, our agreement is not to be construed to include endorsement of last-minute changes made by other agencies which have not been reviewed by this agency.

Sincerely yours,

Francis T. Mayo

Francis T. Mayo
Interim Regional Coordinator

FEDERAL POWER COMMISSION
REGIONAL OFFICE

United States Custom House
610 S. Canal Street, Room 1051
Chicago, Illinois 60607

June 18, 1971

Colonel John T. Rhett
Chairman, Wabash River Basin Comprehensive
Study Coordinating Committee
Louisville District, Corps of Engineers
P. O. Box 59
Louisville, Kentucky 40201

Dear Colonel Rhett:

We have completed our review of the final field level review draft of the Wabash River Basin Comprehensive Study Summary Report and supporting appendices. Our comments on the main report and the twelve appendices have been previously transmitted to you and/or author agencies. This letter is to indicate the general agreement of this office with the Comprehensive Plan recommended by the Wabash Coordinating Committee.

Our general agreement with the recommended Comprehensive Plan is made at field level and, as such, is not to be construed as binding upon the Federal Power Commission itself.

Sincerely yours,

Lenard B. Young
Regional Engineer

Wabash Valley Interstate Commission

302 REA BUILDING
TERRE HAUTE, IND. 47801
PHONE 812 + 232-5076

June 21, 1971

Colonel John T. Rhett, Chairman
Wabash River Basin Comprenhensive Study
Coordinating Committee
Louisville District, Corps of Engineers
Postoffice Box 59
Louisville, Kentucky 40201

Dear Colonel Rhett:

We have completed our review of the final field level review draft of the Wabash River Basin Comprehensive Study Summary Report and supporting appendices. Our comments on the main report and the thirteen appendices have been previously transmitted to you and/or author agencies. This letter is to indicate the Wabash Valley Interstate Commission's general agreement with the Comprehensive Plan recommended by the Wabash Coordinating Committee.

Sincerely yours,

WABASH VALLEY INTERSTATE COMMISSION

George D. Gettinger

George D. Gettinger
Executive Director

GDG:ded

RICHARD B. OGILVIE
Governor

RAY C. DICKERSON
Director

STATE OF ILLINOIS

DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT

June 23, 1971

Colonel John T. Rhett
District Engineer
Corps of Engineers
Department of the Army
Louisville District
P. O. Box 59
Louisville, Kentucky

Dear Colonel Rhett:

Reference is made to your letter requesting State comment on the Main Report of the Wabash River Basin Comprehensive Study.

The Illinois Natural Resource Development Board has reviewed the draft and has no adverse comment to make providing the conclusions and recommendations reached by the Environmental and Plan Formulation Subcommittees in Indianapolis on June 22, 1971, are incorporated in the final draft.

In addition, the Illinois Department of Conservation wishes the following comments noted:

> "On page 246, last sentence in column 1, the statement is made, 'The extra flow provided by reservoirs would allow less treatment or will allow high level treatment facilities to be installed at later dates than otherwise would be needed.' This is contrary to the general policy expressed in other reports. Appendix F - Water Use and Stream Quality, makes reference to the fact that flow augmentation should not be used in lieu of advanced treatment."

Colonel John T. Rhett
Page 2
June 23, 1971

"The Department of Conservation is opposed to the proposed reservoir on Salt Fork near Danville. We expressed this same disapproval when we reviewed the Plan Formulation Report - Appendix C. Salt Fork is a good natural and scenic stream with several clubs and private cottages along some stretches. A reservoir on Salt Fork along with the Middle Fork Reservoir already planned would destroy the two best natural streams in the Danville area."

Sincerely,

Ray C. Dickerson

Ray C. Dickerson

STATE of INDIANA

DEPARTMENT OF NATURAL RESOURCES

INDIANAPOLIS

46204

June 17, 1971

Colonel John T. Rhett, Chairman
Wabash River Basin Comprehensive Study
Coordinating Committee
Louisville District, Corps of Engineers
P.O. Box 59
Louisville, Kentucky 40201

Your ORLPD-P

Dear Colonel Rhett:

We have completed our review of the final field level review draft of the Wabash River Basin Comprehensive Study Summary Report and supporting appendices. Our comments on the main report and the thirteen appendices have been previously transmitted to you and/or author agencies. This letter is to indicate the general agreement of the State of Indiana with the Comprehensive Plan recommended by the Wabash Coordinating Committee.

Sincerely yours,

John R Lloyd

John R. Lloyd
Coordinating Committee Representative
for the State of Indiana

JRL/WJA:gm

JOHN J. GILLIGAN
GOVERNOR

WILLIAM B. NYE
DIRECTOR

STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
OHIO DEPARTMENTS BUILDING
COLUMBUS 43215

June 24, 1971

Colonel John T. Rhett, Chairman
Wabash River Basin Comprehensive Study
Coordinating Committee
Louisville District, Corps of Engineers
P. O. Box 59
Louisville, Kentucky 40201

Dear Colonel Rhett:

We have completed our review of the final field level review draft of the Wabash River Basin Comprehensive Study Summary Report and supporting appendices. Our comments on the main report and the thirteen appendices have been previously transmitted to you and/or author agencies. This letter is to indicate our general agreement with the Comprehensive Plan recommended by the Wabash Coordinating Committee.

Sincerely,

S. L. Frost
Deputy Director for Water

SLF/drh

ORESTRY AND RECLAMATION • GEOLOGICAL SURVEY • LANDS AND SOIL • OIL AND GAS
ARKS AND RECREATION • SOIL AND WATER DISTRICTS • WATER • WATERCRAFT • WILDLIFE

DEPARTMENT OF THE ARMY
LOUISVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 59
LOUISVILLE, KENTUCKY 40201

ORLPD

24 June 1971

Wabash River Coordinating Committee
Office of the Chairman
U. S. Army Engineer District, Louisville
P. O. Box 59
Louisville, Kentucky 40201

Gentlemen:

The following constitutes the field level comment, of the U. S. Army Corps of Engineers, relative to the Wabash River Basin Comprehensive Study and the report thereon.

The Corps of Engineers supports the comprehensive plan presented in the report. The Early Action Plan of development and preservation features is responsive to the near term needs for water and related land resources development in the categories of flood control, water supply, water quality control and public health, agricultural conservation and management, environmental resources and regional development. In conjunction with the Long Range Plan, it provides a blueprint for development to achieve optimum utilization of the Basin's water.

In the Corps' mission to finalize the report and thirteen appendices, review comments have been carefully considered and discussed with author agencies. I believe some of the comments, and of course the report itself, will necessarily deserve continuing review as new information and techniques are developed. At this time, the assumptions and criteria upon which the Wabash studies were based appear valid. Recommendations contained in the Main Report reflect the consensus of the Coordinating Committee.

I am pleased with the progress in Wabash planning which the report represents and with the valuable information and suggestions it offers

ORLPD
Wabash River Coordinating Committee

24 June 1971

for the future development of the Wabash Basin. The output of our study reflects the true interdisciplinary nature of its input, and for the Corps of Engineers, Louisville District, it has been a real pleasure to have been a part of this cooperative effort.

Sincerely yours,

John T. Rhett
JOHN T. RHETT
Colonel, Corps of Engineers
District Engineer